Software

PHOTOMOD 4.4

Module

PHOTOMOD GeoMosaic

USER MANUAL

Racurs, Moscow, 2009

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1. General info

Program **PHOTOMOD GeoMosaic** is used for creating mosaic from initial images. Images to be included into mosaic must be georeferenced. Nevertheless you can merge non-georeferenced images using ground control points' coordinates if necessary. The output ***mosaic*** may be also split into quadrangle sheets specified by user.

Created mosaic is referenced to selected coordinate system and has a cell size defined by user. Tools of brightness adjustment and creation of ***regions of interest (ROI)*** – fragments of each source image included to the output mosaic, are also available. Borders of regions of interest are named ***cutlines***.

2. Installation, starting and uninstall of PHOTOMOD GeoMosaic

Use **setup.exe** file from the CD-ROM to install **PHOTOMOD GeoMosaic** module. The disk space requirement is about 50 MB.

You should also consider the following:

- prior to **PHOTOMOD GeoMosaic** installation on the computer where **PHOTOMOD** system has been installed, close all **PHOTOMOD** applications including **PHOTOMOD System Monitor**
- you should be registered as **Administrator** if working in Windows NT or Windows 2000
- the hard lock key drivers are installed automatically along with the **PHOTOMOD** system. In case of any errors with the system protection try to install key drivers “manually” by running of **HASPUsersetup.exe** from **HASP** folder in distribution kit.

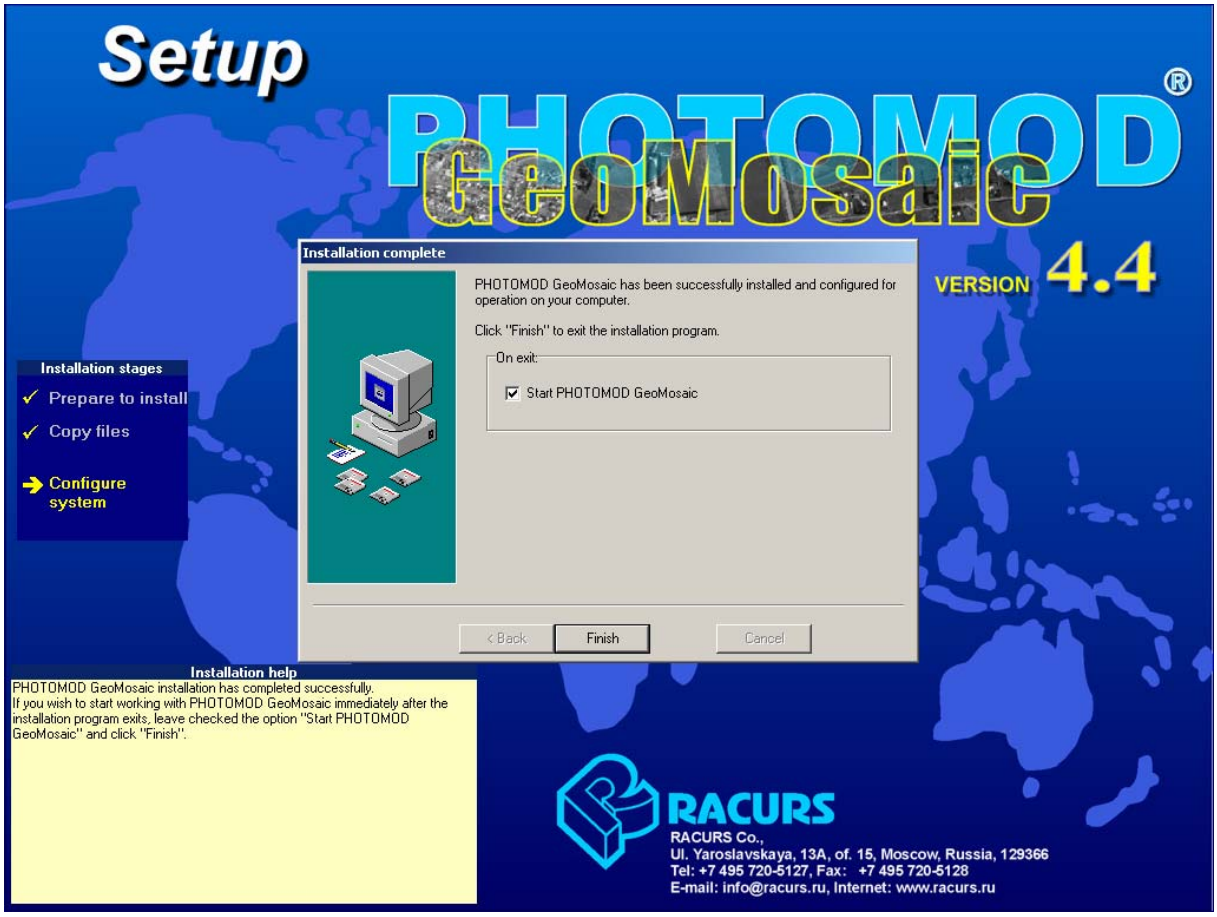
Setup
PHOTOMOD®
GeoMosaic
VERSION 4.4
Installation complete
PHOTOMOD GeoMosaic has been successfully installed and configured for operation on your computer.
Click "Finish" to exit the installation program.
On exit:
Start PHOTOMOD GeoMosaic
< Back
Finish
Cancel
Installation stages
Prepare to install
Copy files
Configure system
Installation help
PHOTOMOD GeoMosaic installation has completed successfully.
If you wish to start working with PHOTOMOD GeoMosaic immediately after the installation program exits, leave checked the option "Start PHOTOMOD GeoMosaic" and click "Finish".
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Fig.1 **PHOTOMOD GeoMosaic** system installation

All setup stages are indicating in left (deep blue) small window with brief instructions in yellow window **Installation help** (Fig.1). You should follow the instructions and pass through all the stages.

PHOTOMOD GeoMosaic is standalone program and is launched from menu **Start | Programs | PHOTOMOD GeoMosaic** or by pushing the icon , created after installation on Windows Desktop.

To uninstall **PHOTOMOD GeoMosaic** system from your computer, use the command **Start | Programs | PHOTOMOD GeoMosaic | Uninstall** or the standard remove programs procedure from OS Windows Control Panel.

3. Operating systems

PHOTOMOD system works under OS Windows 2000 and OS Windows XP operating systems.

4. Protection

PHOTOMOD GeoMosaic system is protected by **HASP** hard lock key from **Aladdin Co**. The hard lock key drivers are installed automatically along with **PHOTOMOD GeoMosaic** module. In case of any errors with the system protection try to install key drivers “manually” by running **HASPUsersetup.exe** from **HASP** folder in distribution kit.

5. Recommended procedure of mosaic building

Once **PHOTOMOD GeoMosaic** module is opened, load initial images to be included into output mosaic using building parameters, chosen by user. Initial images opened by the main menu command **Project | Add images** (duplicated by the icon), may be in the following raster formats:

- **Tag Image File Format (TIFF)** – TIFF and GeoTiff format (containing special parts (“tags”) for raster georeferencing information)
- **Windows Bitmap File (BMP)**
- **VectOr Raster Maps (RSW)** – raster formats of **PHOTOMOD VectOr** module
- **ERDAS IMAGINE (IMG)** – ERDAS system raster format
- **NITF (NITF)**
- **JPEG (JPEG)**
- **GIF (GIF)**
- **PNG (PNG)**
- **PCIDSK (PIX)** – raster format with georeference in the heading developed by PCI Geomatics company
- **JPEG2000 (JP2)** – raster format with jpeg-compressing and georeference information in its header, output image in this format will have volume limited up to 500 Mb
- **USGS DEM (DEM)**.

Note. Palette images of TIFF, GIF and BMP formats could be also loaded and processed correctly in PHOTOMOD GeoMosaic module

Initial images must be georeferenced. Nevertheless you can open non-georeferenced images in **PHOTOMOD GeoMosaic** and reference them (create georeference file) using

ground control points, in image georeference window, see the chapter 7.4 Raster image georeferencing.
Prior to mosaic creation you should specify mosaicking parameters in **Parameters** window opened by pushing the icon or selecting menu command **Mosaic | Parameters**, see the chapter 8 Parameters and preferences.

In the same window (opened by menu command **Mosaic | Parameters**) on **Mosaic** tab you can set the parameters of the mosaic file compression (if necessary), as well as background color and georeference file type. After pushing the **Scale** button, an additional panel is opened allowing you to input the scale of resulting mosaic (by filling in the **Scale** field) and also to recalculate its size and resolution (see the chapter 8.1 Mosaic).

Since the initial images of the block have considerable brightness and color differences, an additional processing is required to obtain visually continual mosaic. Set global and local brightness adjustment parameters on **Brightness adjustment** tabbed page in **Parameters** window to perform such processing. If the neighbor images of the block differ in brightness and color, use the option **By average brightness** for global adjustment.

The local adjustment improves the brightness inside each image. In most cases it is also recommended to use the option **Seams feathering** for brightness differences adjustment on merging edges of the images (see the chapter 8.2 Brightness adjustment).

Create regions of interest (ROI) on the initial images, according to the rules described in the chapter 7.2.2 Cutlines creating rules. On this stage you can also set the order (“upper-lower”) of images supposed to be included to the resulting mosaic.

Build mosaic preview (see the chapter 9 Mosaic preview) to estimate resulting image quality, correct building parameters if necessary.

If brightness and color differences are not properly adjusted and are visible on preview, you have to change local adjustment parameters and global adjustment type. You can also change cutlines close to unsatisfactory parts of image to improve the local adjustment. All these efforts lead to the required brightness quality.

If you would like to split the resulting mosaic into sheets, check the option **Regular splitting** on **Split into sheets** tab and set sheets boundaries (south and west) and size in **Splitting parameters** window opened by pushing the **Parameters** button on the same tab (see the chapter 10 Splitting mosaic into map sheets). After pushing the **Apply** button sheets number is calculated automatically. You can correct this number if needed and close **Splitting parameters** window and also **Parameters** window by **OK** button.

After that start mosaic creation with preset parameters. See the chapter 11 Building mosaic.

6. Main program menu

After starting, **PHOTOMOD GeoMosaic** opens a window (Fig.2) with a main menu in its upper part.

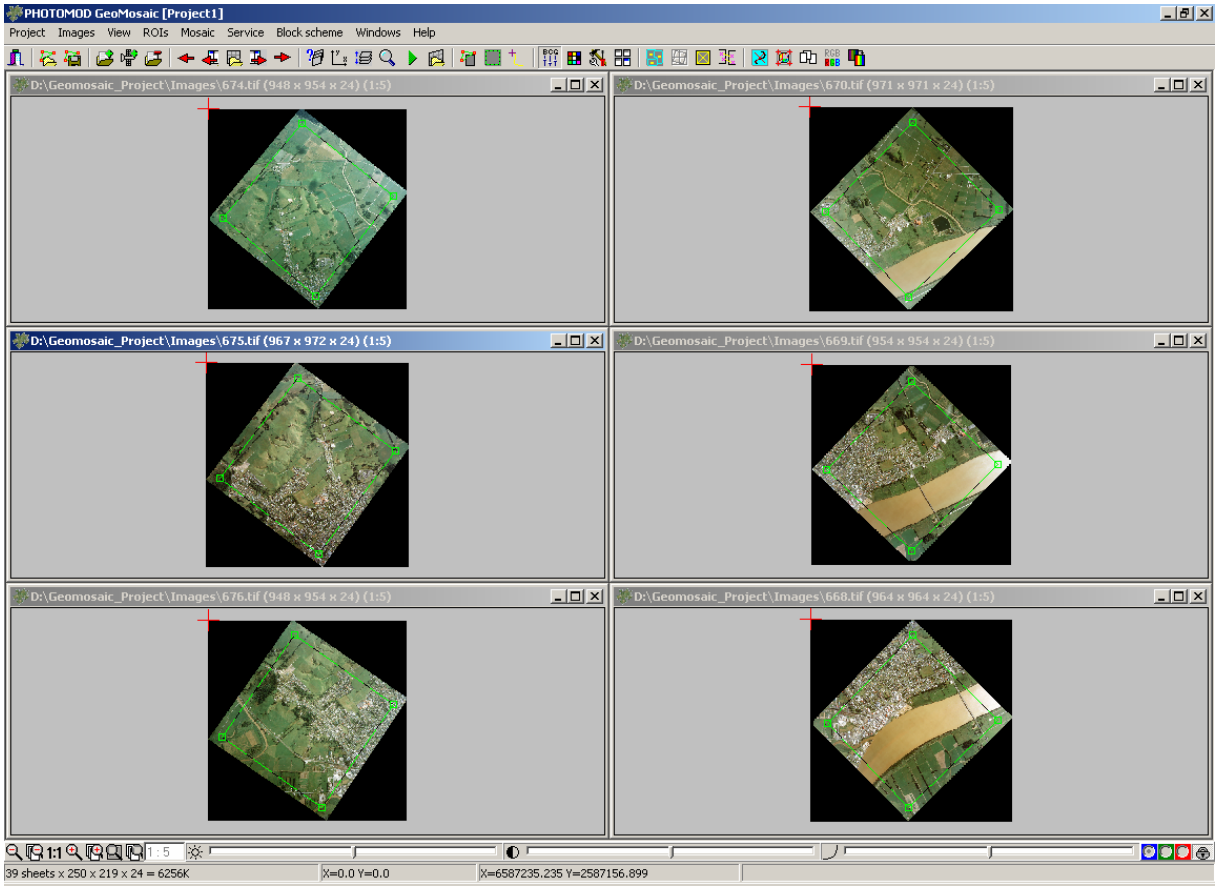

PHOTOMOD GeoMosaic [Project1]
Project Images View ROIs Mosaic Service Block scheme Windows Help
D:\Geomosaic_Project\Images\674.tif (948 x 954 x 24) (1:5)
D:\Geomosaic_Project\Images\670.tif (971 x 971 x 24) (1:5)
D:\Geomosaic_Project\Images\675.tif (967 x 972 x 24) (1:5)
D:\Geomosaic_Project\Images\669.tif (954 x 954 x 24) (1:5)
D:\Geomosaic_Project\Images\676.tif (948 x 954 x 24) (1:5)
D:\Geomosaic_Project\Images\668.tif (964 x 964 x 24) (1:5)
39 sheets x 250 x 219 x 24 = 6256K
X=0.0 Y=0.0
X=6587235.235 Y=2587156.899

Fig.2 **PHOTOMOD GeoMosaic** user interface

The main **PHOTOMOD GeoMosaic** menu consists of the following items:

6.1. *Project*

This menu is used to work with *Mosaic project*, which stores all settings such as brightness, contrast and gamma of images, regions of interest and parameter values. **Project** menu consists of the following options:

- **New** – allows to restore all preview and mosaic building settings into initial ones without module exit, that allows to create new Mosaic project
- **Open** (duplicated by the icon of the main icon bar) – opens a window for selecting file (with MOS extension) with mosaic project for loading
- **Save** (duplicated by the icon of the main icon bar) – saves mosaic project with the same name and MOS extension
- **Save as** – opens a window for selecting file name (with MOS extension) for mosaic project saving with name different from initial
- **Add images** (duplicated by the icon of the main icon bar) – opens a window for selecting source images to be included to the mosaic project, see the chapter 7 Working with a single image). Use standard OS Windows tools (**Shift** and **Ctrl** keys) in this

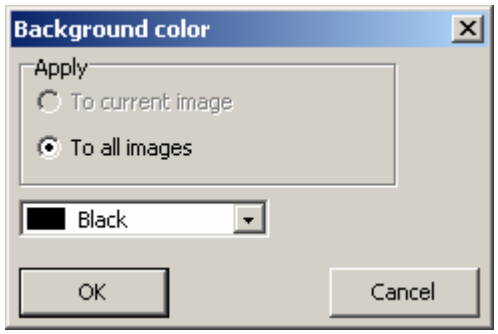
window for group selection of images to be added. The list of images formats processed in **PHOTOMOD GeoMosaic** module see in the chapter 5 Recommended procedure of mosaic building

- **Add satellite images** (duplicated by the icon of the main icon bar) – allows to select the initial space borne images to be added to **PHOTOMOD GeoMosaic** project. See the chapter 7.1.1 Satellite images adding
- **Remove images** (duplicated by the icon of the main icon bar) – opens a window with list of the current project images, to remove selected images from the project. Use standard OS Windows tools (**Shift** and **Ctrl** keys) in this window for group selection of images to be removed. Search of the image in the list by its name is also available
- **Import vectors** – allows to select and import vector objects in DXF, DGN and Shape formats to GeoMosaic project
- **Exit** (duplicated by the icon of the main icon bar or hot keys **Ctrl-X**) – exits **PHOTOMOD GeoMosaic**.

6.2. *Images*

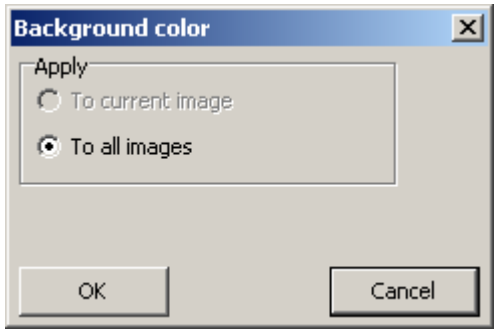
Images menu is used to load source images to **PHOTOMOD GeoMosaic** and includes the following options:

- **Open** (duplicated by the icon of the main icon bar or hot keys **Ctrl-O**) – opens a window of the source rasters for selection and loading a single image which is already existing in the list of images of the current project (see the chapter 7 Working with a single image). While loading rasters (basically for ROI creation and editing) you can open unlimited number of windows. Use standard OS Windows tools (pressed **Shift** or **Ctrl** keys) for the group selection of source image files
- **Next image** (duplicated by the icon of the main icon bar or hot keys **Ctrl-N**) – loads the next image of the source block to the current window
- **Previous image** (duplicated by the icon of the main icon bar or hot keys **Ctrl-P**) – loads the previous image of the source block to the current window
- **Background color** option - allows you to set the background color of the original images, containing non-informative data like the background with a constant value of brightness and color. To manually set the background color for these images, you should select **Images | background color | Set color**, which opens the **Background color** window.



In case a window with one of the source images is open, it is possible to set the color for that image only. Also it is possible to set the background color for all images in the mosaic project.
In case the background is concentrated at the edges of images (for example, due to rotated raster), it possible to automatically define it for each of the images. In order to do it, you should check the **Images |Background color | Automatically** option.

If it is necessary to cancel selection of background for one or all images it is necessary to check the **Images |Background color | None** option, which opens the **Background color** window.



In order to make the specified background color transparent, you should use menu command **Images | Background color| Transparent background** when building mosaic

6.3. *View*

This menu is intended to setup the image view in active window or in all windows. At that there are the following options:

- **Hide all** – un-visualize all objects
- **ROIs** (duplicated by the icon or **Alt-Z** hot keys) – turns on/off regions of interest (ROI's): all or user defined
- **Cutlines** – turns on/off ***cutlines*** on the image (ROI's borders) to be merged into resulting mosaic (see the chapter 7.2.2 Cutlines creating rules)
- **Tie points** (duplicated by the icon) – hides/shows tie points on images and on preview and resulting mosaic, if ties were created in appropriate window, see the chapter 7.2.4 Tie points search and edit
- **Local adjustment** – in preview or mosaic window turns on/off small rectangles marking the places for local brightness adjustment statistics (see the chapter 8.2.2 Local brightness adjustment)
- **Sheets extents** (duplicated by the icon) – turns on/off borders of sheets in preview or mosaic window, if output mosaic is divided into map sheets, and the appropriate option is marked in **Preferences** window (see the chapter 8.3 Splitting into sheets)
- **Vectors** - turns on/off the display of vector objects
- **Show in all windows** – turns on/off all abovementioned objects in all windows: source images, preview and mosaic.

6.4. *Regions of Interest*

This menu is used to create regions of interest (ROI) – see the chapter 7.2 Creating regions of interest. ROIs are fragments of each source image to be included to the output mosaic. The menu includes the following items:

- **ROIs editor** (duplicated by the icon of the main icon bar) – opens an additional button bar, intended for creating and editing of **Regions of interest**. See the chapter 7.2.3 Creating and editing regions of interest

- **Trim off images edges** (duplicated by the icon of the main icon bar) – used to change a size of rectangular default ROIs. See the chapter 7.2.1 Regions of interest by default.
- **Polygon ⇔ rectangle** – allows to convert selected ROI to the rectangle and delete other ROIs on the current image. In this case the ROI becomes available for editing as described in the chapter 7.2.3 Creating and editing regions of interest
- **Polygon ⇔ rectangle for all** – the same operation for all images
- **Autobuilding** – automatic ROI creation on selected image
- **Delete all ROIs** – cancels ROIs creation and shows default ROIs. See the chapter 7.2.1 Regions of interest by default.
- **Import ROIs** – ROIs import from DXF and Shape format files. See the chapter 7.2.5 Regions of interest import and export
- **Export ROIs** – ROIs export into DXF, Shape or MIF/MID file format. See the chapter 7.2.5 Regions of interest import and export
- **Export cutlines** – cutlines export into DXF, Shape or MIF/MID file format. See the chapter 7.2.5 Regions of interest import and export.

6.5. *Mosaic*

This menu is used to start mosaicking process and parameters selection. It consists of the following options:

- **Parameters…** (duplicated by the icon of the main icon bar) – opens a parameters selection dialog (see the chapter 8 Parameters and preferences)
- **Coordinates** (duplicated by the icon of the main icon bar) – opens a window for displaying and editing coordinates of the mosaic corners and also its width and length
- **Images order** (duplicated by the icon of the main icon bar) – opens a dialog to specify images order in the output mosaic (upper-lower). Used to process images overlapping areas (see the chapter 8.2.4 Additional recommendations)
- **Tie points** (duplicated by the icon of the main icon bar) – opens a window for automatic or manual search of tie points in the area of cutlines on adjacent images. Used for processing of overlap areas on images (see the chapter 7.2.4 Tie points search and edit)
- **Preview** (duplicated by the icon of the main icon bar) – shows mosaic preview with low resolution (see the chapter 9 Mosaic preview)
- **Build** (duplicated by the icon of the main icon bar) – starts mosaicking process (see the chapter 11 Building mosaic)
- **Open** (duplicated by the icon of the main icon bar or hot keys **Ctrl-Alt-O**) – loads previously created mosaic for viewing (see the chapter 11.5 Loading mosaic).
- **Import vectors** – allows to import linear and point objects from DXF and ASCII formats and visualize them over resulting mosaic. You can also import points as a set of X, Y, Z coordinates, by selecting the appropriate option. Import vectors option is available if mosaic window is opened.
- **Create marginalia** - allows creating marginalia for several scales (see chapter 11.6 Creating marginalia for mosaic)

6.6. *Service*

Service menu consists of the following items:

- **Colors** (duplicated by the icon of the main icon bar). Used to set colors for displaying such objects as cutlines, selected ROI, and other objects.
- **Preferences** (duplicated by the icon of the main icon bar). Opens system preferences dialog (see the chapter 8.4 System preferences).
- **Show regulation panel** (duplicated by the icon of the main icon bar or hot keys **Ctrl-T**) – shows/hides lower panel with sliders for brightness/contrast/gamma corrections.
- **Print window** – allows to print any active module window with pre-setting of print options:

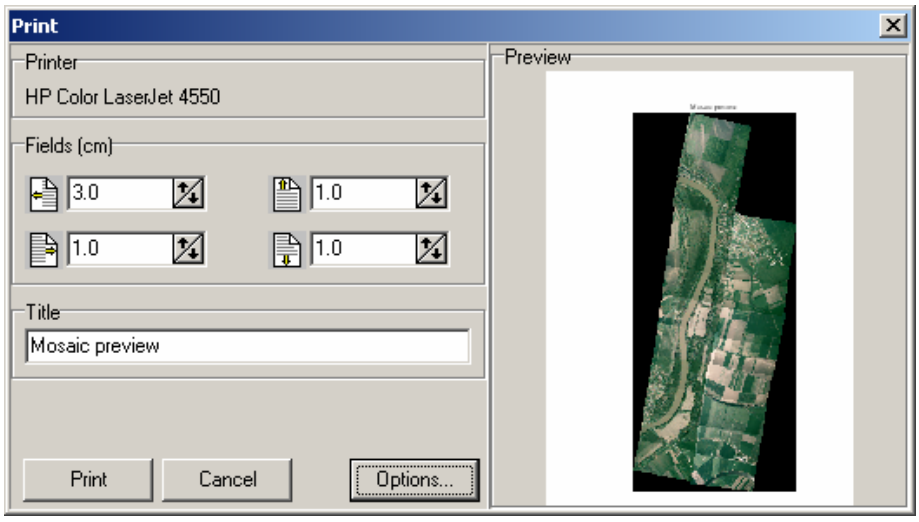


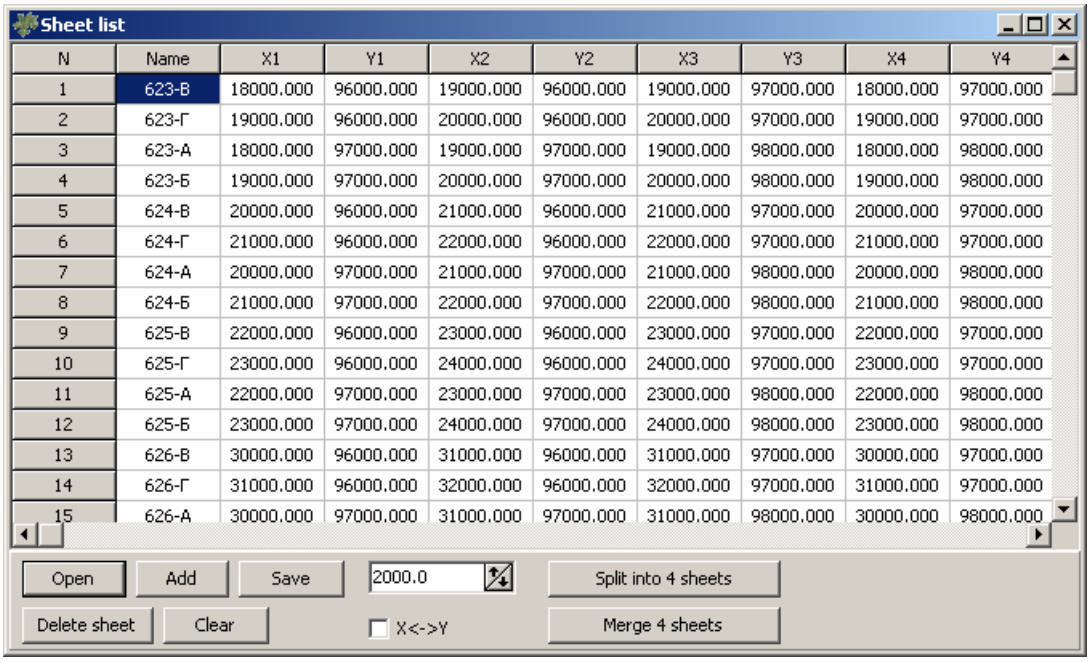
Fig.3 Printing options setting

Left part of this window allows to set up printing options: paper sheet fields, printer selecting and its settings (using the **Options** button), and also input the title of printed image in the appropriate field. You can preview all these settings in preview window in the right part of the window.

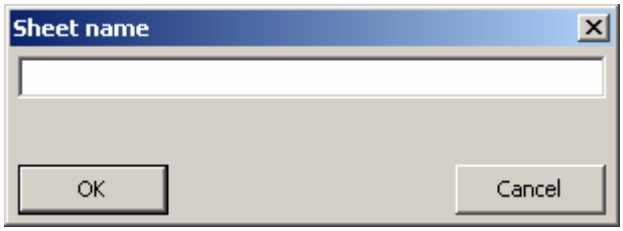
- **Print map** – allows to print any active window of the module with pre-setting of print options and splitting the image into sheets.
- **Execute PHOTOMOD Dust Correct** (duplicated by the icon of the main icon bar) – opens a window intended for cleaning mosaic image from artifacts, see the chapter 11.3 Mosaic editing in Dust Correct application.
- **Raster georeference** (duplicated by the icon of the main icon bar) – opens a window used for raster image georeferencing, see the chapter 7.4 Raster image georeferencing.
- **Images referencing** (duplicated by the icon of the main icon bar) – opens a window used to link raster images to each other, see the chapter 7.5 Images referencing.
- **Delete multiscale images** – deletes pyramidal images (files with *.pyr extension) from folder containing mosaic project, if they were created during images opening or later by the command **Create multiscale images**.
- **Create multiscale images** – creates pyramidal images (files with *.pyr extension), which are used to speed up the project load. The target folder where the pyramided images are saved, is indicated on **Images** tab in **Preferences** window, see the chapter 8.4 Preferences.
- **Pan sharpening** – opens a window used for merging of two images, one of which is black-and-white with high resolution and another one – color with less resolution. The

resulting image is color with high resolution, see the chapter 13 Pan sharpening operation.

- **Image processor** – opens a window used for radiometric correction and geometric transformations of raster images or their fragments, and also includes saving and printing options, see the chapter 19 PHOTOMOD ImageProcessor.
- **Sheet list** – opens a window used for creation of list of map sheets the scanned topographic map to be split to. To get started, open a scanned georefereced image containing sheet borders as raster images. Then use **Service | Sheet list** to set sheet sizes.



To add another sheet to the list, you must double-click the left mouse button in the center of the sheet alleged. A window will appear to specify sheet title.



After setting name and clicking **OK**, sheet will be added to the end of the list.
To remove the sheet should select any cell in line with the sheet and click **Delete** sheet. For the complete list of clean sheets, click **Clear** and confirm clean-up in a warning dialog.
To save sheets as CSV click **Save** button. If **X <-> Y** option is enabled, X and Y coordinates of sheet edges are swapped. You may wish to generate a list of pages in leftist coordinate systems (such as CS-42).
Add button - is intended to add pieces from CSV-file without removing existing ones.
Open button preliminarily removes existing sheets and then loads the contents of this file. With **X <-> Y** option enabled the coordinates of X, Y of sheet borders are swapped while loading.
Quite often the scheme of dividing into sheets of larger scale contains sheets of smaller scale, divided into four parts. Used as a root of name is the name of a sheet with smaller scale with additional suffix. For example, sheet "623-A" of scale 1:5000 is divided into four sheets of scale 1:2000: "623-A-a", "623-A-b", "623-A-c", "623-A-d". To automate such

division use button **Split into 4 sheets**. After clicking it you are prompted to select a file to use for saving sheets of larger scale into and then - to save a new list.
Also implemented is operation of merging four sheets for moving to smaller scale (button **Merge 4 sheets**). By doing so, four neighbouring sheets are merged to one, and the title is cut to remove the last nomenclature letter.

6.7. *Block scheme*

- **Show** (duplicated by the icon of the main icon bar) – opens a *block scheme* on the screen (see the Fig.2). The number of images to be displayed is defined in **Service | Preferences | Windows** panel (see the chapter 8.4 Preferences). The block scheme is used for adding regions of interest (see the chapter 7.2 Creating regions of interest) since it is convenient to see the ROI not only on the current image but also on its neighbors.
- **Build strips** – allows to arrange a set of initial images into strips, see the chapter 8.2.3 Building strips
- **Up** (**Ctrl-Alt-Up** hot keys), **down** (**Ctrl-Alt-Down** hot keys), **left** (**Ctrl-Alt-Left** hot keys), **right** (**Ctrl-Alt-Right** hot keys) – used to load corresponding adjacent scheme portions. The overlap of the current and loading portions of the block scheme is setup in the **Service | Preferences | Windows** dialog (see the chapter 8.4 Preferences).

6.8. *Window*

Window menu is used to locate windows on the screen and includes the following options:
- **Cascade**
- **Tile vertically**
- **Tile horizontally**
- **Minimize all**
- **Close** – closes active window with current image
- **Close all** – closes all windows.

6.9. *Help*

Includes the following items:
- **Contents** (or **F1** key) – runs **Help** system for **PHOTOMOD GeoMosaic** module.
- **About program…** – opens a window with information related to version number, serial number, date of version compiling, etc.

7. Working with a single image

7.1. *Loading images*

The initial images are added to the current project using menu command **Images | Open** (duplicated by the icon of the main icon bar or by **Ctrl-O** shortcut), which opens a window for images selection:

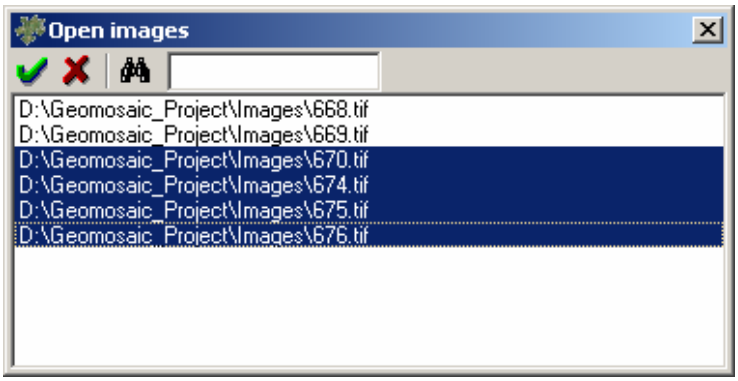


Fig.4 Images selection

This window allows group images selection (along with pressed **Ctrl** and **Shift** keys), as well as images search using its name input to search field, after pushing the button (**Find**). Images selected will be opened in the current project after pushing the button (or **Enter**). You can cancel the selection and close the window by pushing the button (or **Esc**).

Besides, you can use menu commands which open previous and next images of this list, see the chapter 6.2 Images.

If the project does not contain any images you must add them using menu command **Project | Add images** (duplicated by pushing the button). The list of images formats, processed in **PHOTOMOD GeoMosaic** see in the chapter 5 Recommended procedure of mosaic building.

If you need to add space borne images to the project use menu command **Project | Add satellite images** (duplicated by pushing the button), see the chapter 7.1.1 Space borne images adding.

7.1.1. Space borne images adding

Scanner images acquired by different sensors have different formats and are delivered as a file set, which include both images themselves and files with supplementary information, used for their processing. Such sets of files obtained from a remote sensing data supplier and relevant to the images are called ***product***.

For more details on scanner imagery formats processing in **PHOTOMOD GeoMosaic** system, see the chapter 7.1.1.2 Scanner imagery formats.

Thus, imagery folder provided by data supplier contains metadata files of different formats, associated with the images.

Use menu command **Project | Add images** (duplicated by pushing the button) to add images acquired by space sensors. The command opens a dialogue of initial images selection, consisting of two tabs (Fig.5). First of all you should select source image folder containing image product files set on the first tab **Select folder**.

Then open the second tab to select and add the images themselves.

The upper part of this tab consists of three windows: **Products**, **Product files** and **Product images**.

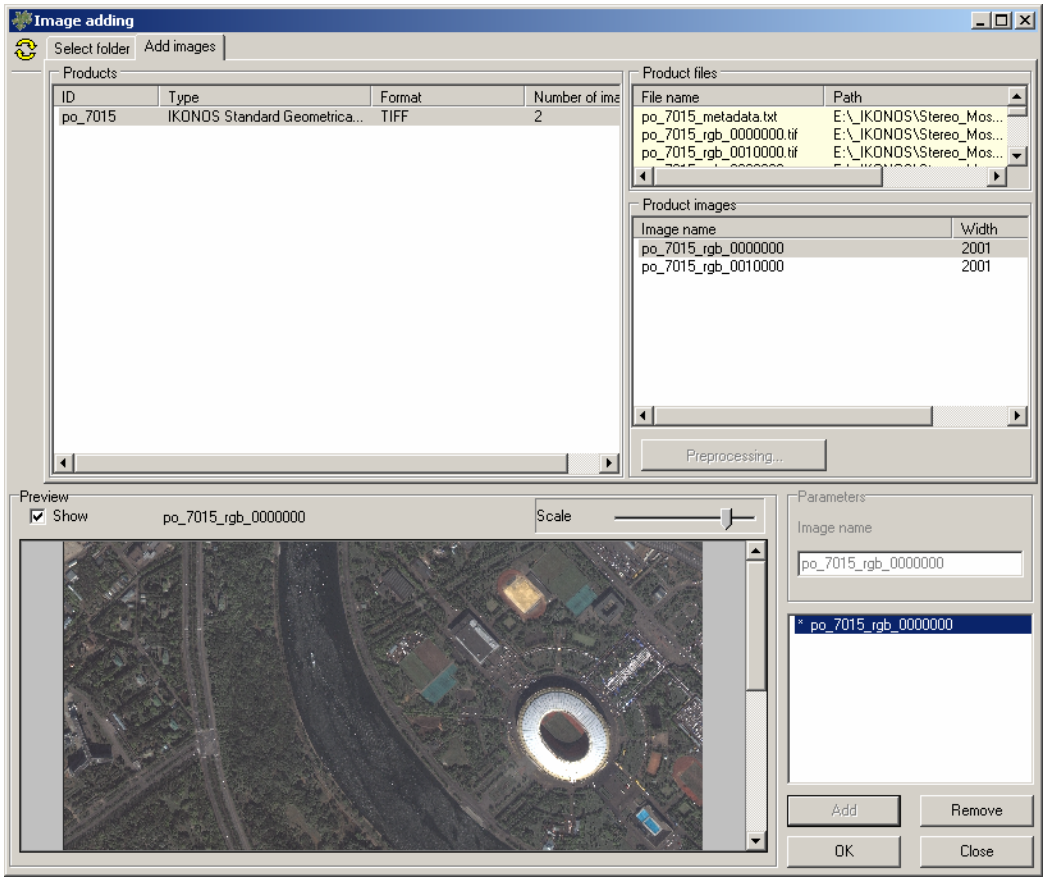


Fig.5 Scanner image selection and adding (by the example of IKONOS image)

In **Products** window imagery ***products*** and their following data are displayed in proper table columns: product identifier, provided by the data supplier, product type, its format and number of images composing the product. In **Type** column you can see sensor type and preprocessing level of IKONOS or QuickBird images for any kind of scanner projects.

Note. It is not recommended to change the initial file names (product identifier, provided by the data supplier, shown in Products window), since it may cause failure of further work with the image, because other files relevant to this product may be linked to initial file name

Product files window contains the list of all files delivered along with the image and used for its processing. In table columns additionally to files names, their path, size and extension type are shown.

Product images window contains the list of all images in the product as well as their width and height in pixels. When you select an image in this window, it will be displayed in preview window if the **Show** option is **on**. You can also change selected file's name (inner name in **PHOTOMOD GeoMosaic** module) in **Name** field of **Parameters** panel, and also set up the compression coefficient for raster or invert it (from positive to negative), using appropriate options in the **Parameters** panel.

Note. You should change the image name if its length exceeds 32 symbols, at that it is recommended to remove the beginning of the name and to leave the ending, which could contain the number of the image in the product files set

When all necessary images are selected, push the **Add** button to complete the procedure.

If the source raster has more than 8 bits per sample (in images acquired by IKONOS or QuickBird sensors for instance), it is recommended to perform dynamic range adjustment procedure before image adding to **PHOTOMOD GeoMosaic** project (see the chapter 7.1.1.1 Image radiometric correction).

After the adding procedure and radiometric correction are completed push **OK** to open the **Saving parameters** window. Then select images saving format (in the **File format** field) and target folder (in the **Folder** field). Refer to the chapter 11.1 Building and viewing mosaic for the details about images formats used in **PHOTOMOD GeoMosaic**.

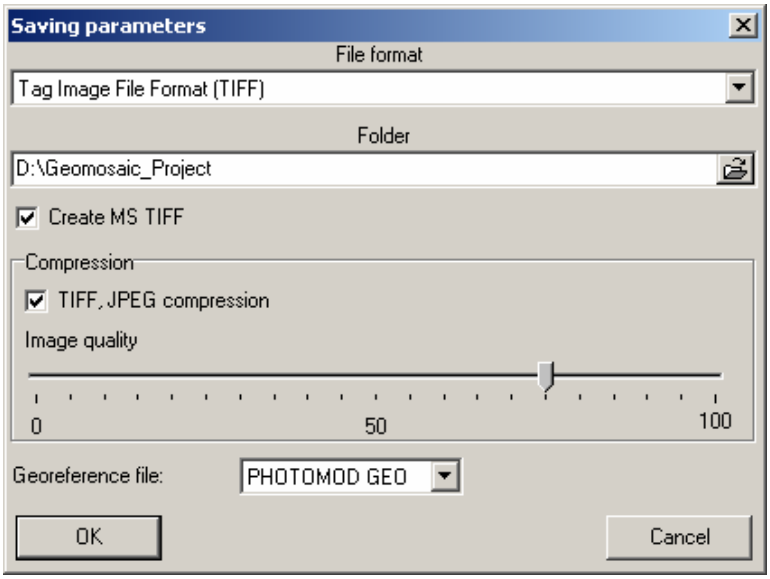


Fig.6 Scanner images adding

Create MS TIFF option is used to build pyramid image of output mosaic inside TIFF or GeoTIFF file created, that allows to speed up the image zooming.

Options in the **Compression** panel are used to reduce the output mosaic image. Check the **TIFF, JPEG compression** box and use the **Image quality** slider to apply the compression. The default value of compression quality is 75%.

Georeference file drop-down menu allows to select the format of the additional file created along with output mosaic in TIFF format and containing the information for mosaic referencing to coordinate system.

The georeference of space images is acquired from metadata delivered from product supplier. It is saved along with added scanner image in **PHOTOMOD GeoMosaic** format. At that georeference contains coordinates of the image corners (latitude and longitude in degrees) in WGS-84 coordinate system.

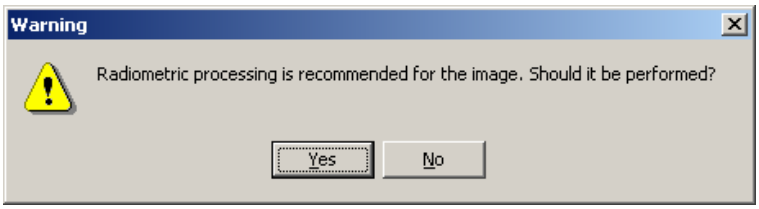
When saving an output mosaic of space borne images you should transform it from lat/long coordinate system into coordinate system selected in mosaic parameters window in the **Set coordinate system** panel, see the chapter 8.1 Mosaic and 14 Coordinate system transformation.

See more details about georeference files formats in **PHOTOMOD GeoMosaic** in the chapter 15 Georeference file.

7.1.1.1. *Image radiometric correction*

Images, to be added to PHOTOMOD **GeoMosaic** module, often are not tuned enough for their comfort viewing and processing. This may be caused by the optical features of survey equipment, radiant energy converter, analog-digital converter, etc. Such images require preliminary radiometric processing to improve their visual features. Besides, the data acquired by some sensors (IKONOS, QuickBird, Cartosat), is supplied in format of 10-12-bit per channel. For further processing in PHOTOMOD **GeoMosaic** module it should be transferred to 8-bit per channel format.

After pushing the **Add** button while image selection process in the **Image adding** window (see the chapter 7.1.1 Space borne images adding), the system will ask you to perform dynamic range adjustment procedure of selected image automatically. If you would not like to correct images radiometrically, push the **No** button in the dialogue shown below:



and the image will be added without histogram changing.

However it is recommended to perform radiometric correction in the window opened by pushing the **Yes** button.

The same **Radiometric correction** window could be opened by pushing the button **Preprocessing** in the **Product images** field in the **Images adding** window.

The window title bar contains image name, its pixel size (width, height) and number of bites per pixel. While the window opens the pyramidal image is building. That pyramidal image helps to speed up the raster viewing in 2D window.

Note. Temporal pyramidal image is created in Temp subfolder of PHOTOMOD GeoMosaic configuration folder. That is why you should have enough room on hard disk, otherwise the pyramid will be not created and image visualization at 2 and more zoom will be slow

Temporal pyramidal image and histogram used for preprocessing of the image to be added, could be deleted after closing the **Radiometric correction** window, if the option **Remove pyramid and histogram after close** is on.

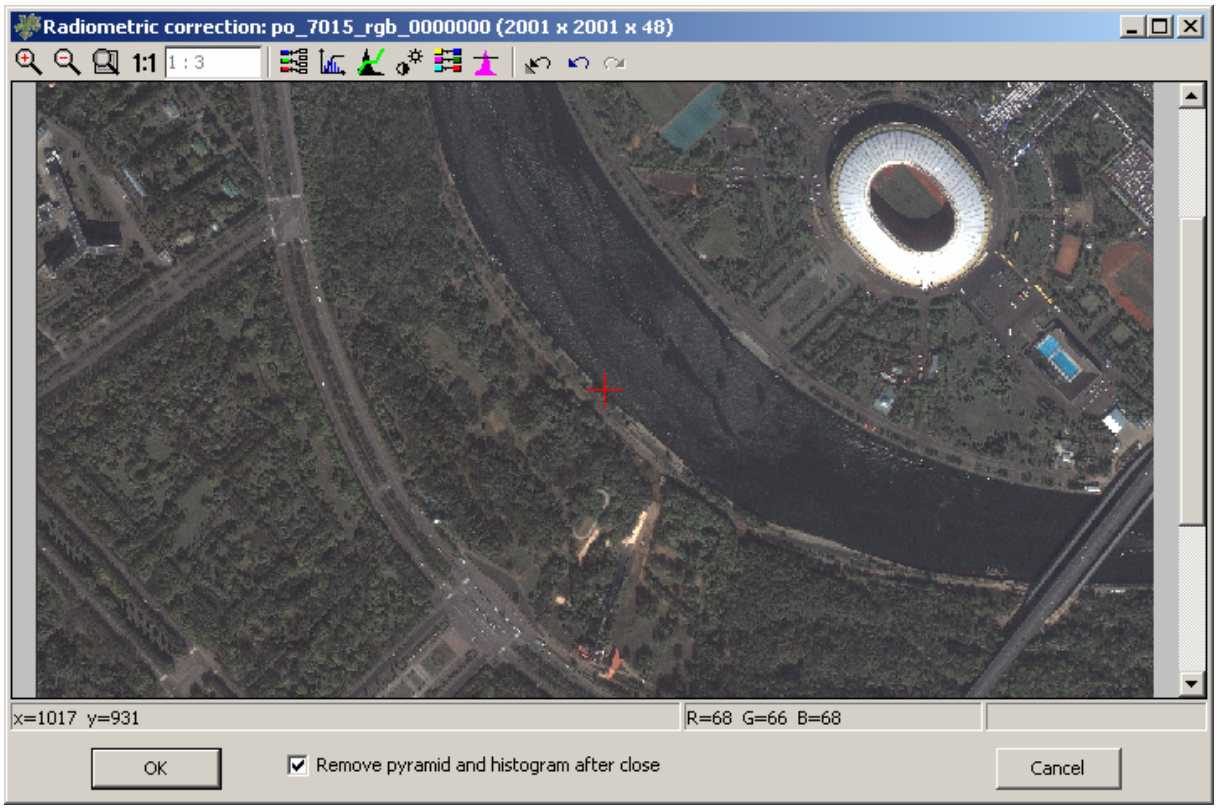
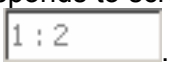


Fig.7 Radiometric correction window

In **Radiometric correction** window you may change the results of automatic conversion manually using tools described below.

The following tools are used for image scale management:

- (duplicated by "*" key) - one step zoom in
- (duplicated by "/" key) - one step zoom out
- (duplicated by "**Alt-Enter**" shortcut) - fits image to window
- (duplicated by "**Alt-1**" shortcut) - 1:1 zoom (image cell corresponds to screen pixel)

Current ratio between image size and scale is shown in the window  .

For zooming in by zoom box, press **Ctrl-Alt** keys and draw the box by the mouse. Use **Ctrl-Alt-Shift** keys for zooming out by zoom box. For "panning" over the image move a mouse cursor along with pressed **Alt** key.

If there is more than 8 bits per channel in the image, the histogram stretching operation is applied for the whole brightness range automatically, for each channel independently.

The following tools are used for image radiometric correction:

Operation of histogram stretching for the whole brightness range for each channel is started from the window opened by the button (**Channels**).

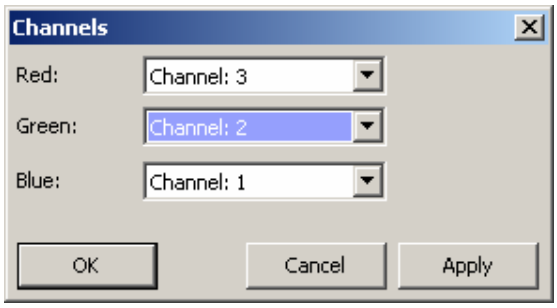


Fig.8 Channels order window

Note. The initial order of channels is setup depending on type of the image to be added

The button opens a window used for auto levels setup operation.

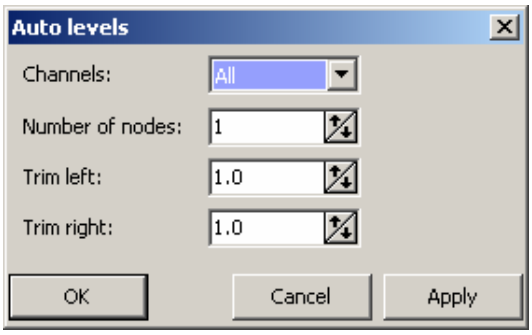


Fig.9 **Auto levels** window

The operation includes stretching the histogram of the initial image on the whole brightness range. Select necessary channel in **Channels** field, and apply the next parameters of histogram stretching to them. The **Number of nodes** parameter specifies the number of intervals of intermediate feature, which is used for histogram stretching. Parameters **Trim left** and **Trim right** show a percent of histogram area to be cut off, and not be considered in the operation.

To view a histogram of the image to be added and to adjust a transfer function used to setup arbitrary brightness transformation, open a window by pushing the button (**Curves**).

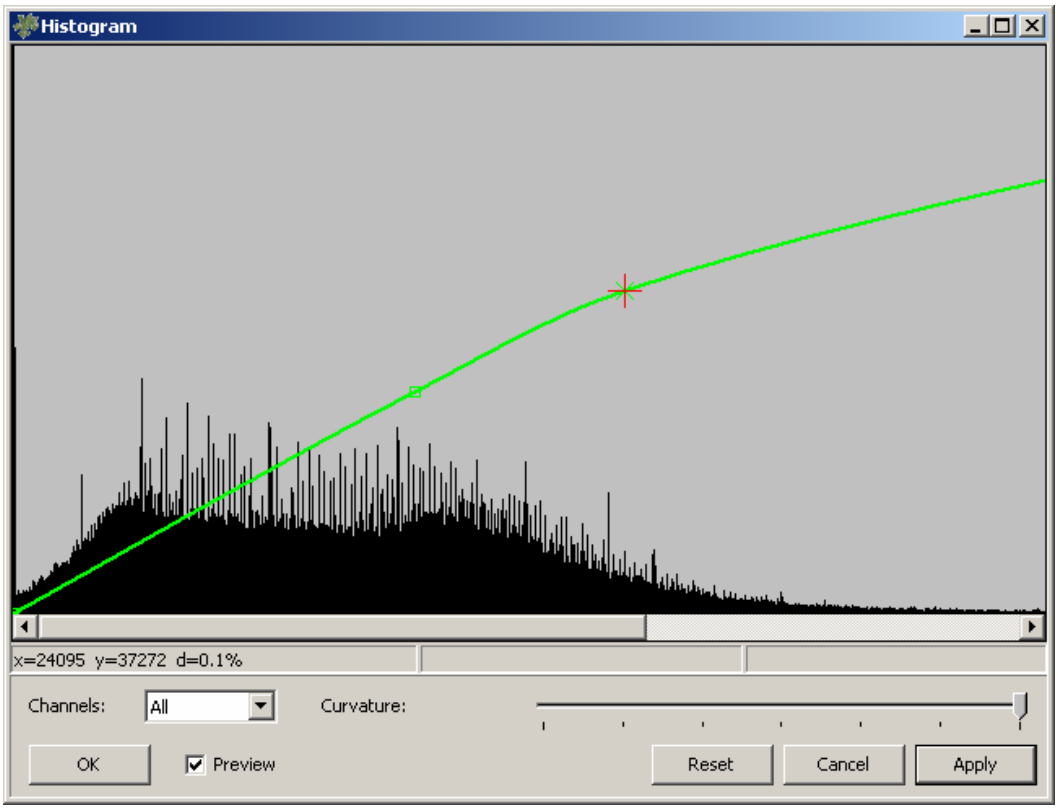


Fig.10 **Histogram** window

Graphically the function is visualized as a green curve. In X axis there are values of image brightness before transformation, and in Y axis – after it. Transfer function is setup using node points (small green squares). Between nodes the function line is Bezier curve with curvature degree from 0% (leftmost position of the **Curvature** slider) to 100% (its rightmost position). When curvature degree is 0% the function is shown as a broken line segment.

To add node point place marker to needed point of a window and press **Insert**.

To select node point just click somewhere close to it. You can move selected point by moving a mouse cursor along with pressed **Ctrl** key. Press **Delete** to delete selected point and **Esc** to cancel selection.

Use "**/**" and "*****" keys on numeric keyboard to zoom in/ zoom out the histogram. Use **Alt-Enter** shortcut to show the histogram in full and **Alt-1** to show it in 1:1 scale.

In case of color image the transfer function is setup either for all color channels simultaneously or for each one. Use **Channels** drop-down list to select color channel to be adjusted.

To apply all changes in image window immediately mark the **Preview** check box.

Marker X, Y coordinates and histogram value for the current brightness reading in percent are shown in **Status** line in the bottom of the window.

The button opens a window **Brightness-Contrast-Gamma** used for adjusting of the corresponding features for each image channel, or for all of them at once. If the option **Live preview** is on, the image changes are applied “on-the-fly”, without pushing the **Apply** button.

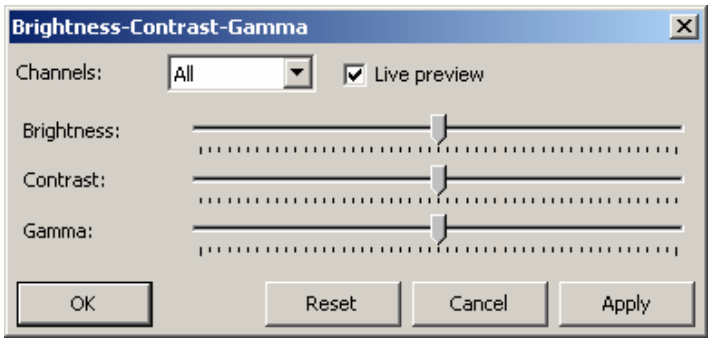


Fig.11 Brightness-Contrast-Gamma adjustment

The button opens a window used for color balancing (Fig.12). You can shift the image balance to cyan, red, magenta, green, yellow or blue color. Resulting brightness is not changed at that. You can also shift balance of each color in numeric form –100 to 100 in the **Values** field.

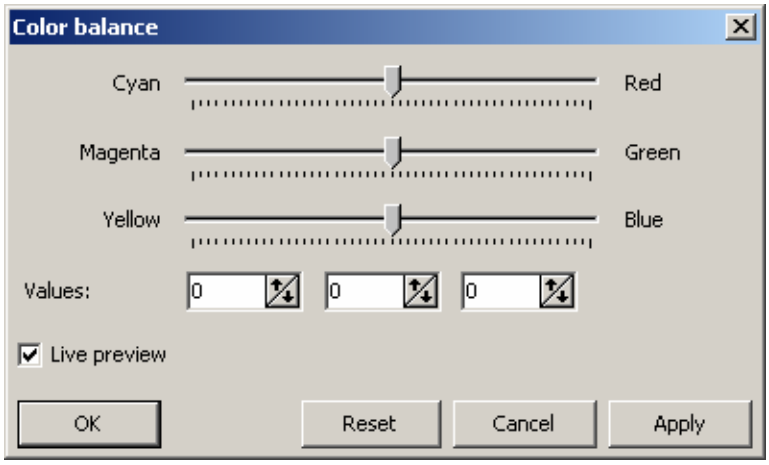


Fig.12 Color balance window

The button (**Filters**) opens a window used for improving of visual quality of initial image using it's processing by different filters.

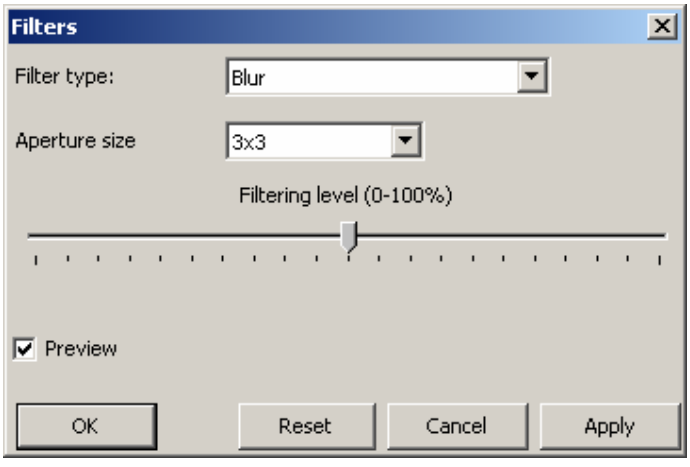


Fig.13 Window for image filtering

Select processing type in the **Filter type** drop-down list from the following items:

- **Blur** – intended for dithering of initial image details
- **Gaussian blur** – kind of smoothing filter, where transfer value is not a linear function (as in **Blur** function), but a section of Gaussian function ("bell curve");
- **Sharpen** – allows to highlight and intensify a differences between image's details
- **Sharpen edges** – alike a **Sharpen** filter but performs filtering only when brightness differences between details are exceeding some threshold. Suits very well for identifying and highlighting of objects borders which are homogeneous insight (fields, for instance), at that inner part of objects remains unchanged
- **Median** – non-linear filter intended mainly for impulse noises filtration (single pixels with unnatural brightness)
- **Sobel** – non-linear differential filter, which is the first derivative of the initial raster. Used for acquisition of contour borders on raster image.

To apply all changes in image window immediately mark the **Preview** check box.

The button (undo) cancels the last action, (redo) – redoes the last cancelled action. The button cancels all actions performed, and undo-redo operations list depth is 10 actions.

Note. All operations are applied to the current image state

When you get an acceptable correction result in the preview window push the **Close** button and go back to **Adding images** dialogue – see the chapter 7.1.1 Space borne images adding.

The procedure is not the only image enhancement/adjustment operation; other modules of **PHOTOMOD** system include brightness-contrast-gamma and color balancing procedures; the **Mosaic** module has advanced possibilities to adjust radiometry as well.

7.1.1.2. *Scanner imagery formats*

Note. While adding scanner image to the project, just select the path to the target folder with imagery and product metadata files obtained from the data supplier. PHOTOMOD GeoMosaic system will recognize needed format and the image will be opened automatically

Satellites/Sensors	***Formats***
SPOT 1-4/HRV, HRVIR	SISA, CAP
SPOT 5/HRG, HRS	DIMAP
TERRA/ASTER	HDF
EROS A1/NA 30	RAW, TIFF
FORMOSAT-2	DIMAP
LandSat IRS SPOT 1B ASTER 1B **…**	TIFF/GeoTIFF, HDF Super Structured, HDF, Fast C
IKONOS, Quick Bird OrbView-3, CARTOSAT-1	TIFF/GeoTIFF (+RPC)

Any scanner images preliminary converted into TIFF or JPEG format could be processed in **PHOTOMOD GeoMosaic** (see the chapter 7.1.1 Space borne images adding). Besides, the following formats of scanner images are supported:

- **SPOT** – **CAP**, **DIMAP** and **SISA** format. In **PHOTOMOD GeoMosaic** system **SPOT** images of 1A preprocessing level (radiometric correction) are processed. This format is used for all modifications of SPOT satellites (from 1 to 5). You need the following 5 files (XY – arbitrary digits).
  - IMAG_XY.dat
  - LEAD_XY.dat
  - NULL_XY.dat
  - TRAI_XY.dat
  - VOLD_XY.dat

- **TERRA/ASTER** – **HDF** format. **ASTER** images of 1A preprocessing level (with radiometric correction only) are processed. Geometrical model of sensor as well as initial approximations of the orbit and sensor orientation are restored using additional information coming alone with the images.

  While adding images to the project, **PHOTOMOD GeoMosaic** allows to input file format ASTER HDF. It is recommended to choose from the delivery set VNIR 1 or VNIR 2 bands (optical range), or VNIR3B and VNIR3N (close infrared, 15m resolution).

- **EROS** – **RAW** format. The product of **1A** pre-processing level is supported in **RAW** and **TIFF** formats either in 8-bit or 16-bit types.

- **FORMOSAT-2** – **DIMAP** format. The product contains files of the following formats: Images.tif and metadata.dim.

- **IRS** (**1C**, **1D**) – **IRS P5, P6** images are loaded from the following formats:
  - **Super Structured format** – imagery X.pan file, where X is a digit
  - **HDF** from **Scanex** – processing of 1B-level images (overlapped strips);
  - **Fast C** from **Scanex** – header file <name>.fst and image file <name>.X.fst, where X is a digit.
  - **Fast C** from **Euromap** – image file <name>.xyA and header file <name>.xyB, where x,y – some symbols, and B depends on A like this:

    A= '0': → B='a';
    A= '1': → B='b';
    A= '2': → B='c';
    A= '3': → B='d';
    A= '4': → B='e';
    A= '5': → B='f';
    A= '6': → B='g';
    A= '7': → B='h';
    A= '8': → B='i';
    A= '9': → B='j';
    A= 'n': → B='k';
    A= 'o': → B='l';
    A= 'p': → B='m';

    A sample of file names:
    - e1q11b4j.1eo – image file
    - e1q11b4j.1el – header file

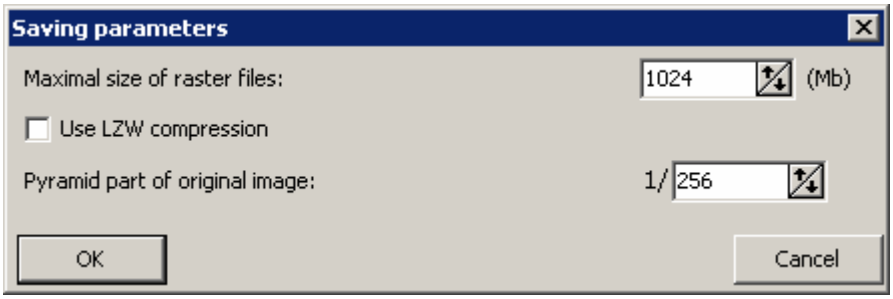
- **IKONOS** – **TIFF/GeoTIFF** format. Current **PHOTOMOD GeoMosaic** version allows to process high resolution IKONOS images of Geo level, both single and stereopairs (**Stereo** product); both with RPC (Rational Polynomial Coefficients) and without them (file containing RPC could be delivered along with the image or not). The supported format is TIFF/GeoTIFF, at that the tags with georeferencing data in GeoTIFF file are ignored. 11-bit images are transforming into 8-bit rasters during the input. When adding the image file in the same folder the program starts to search for the file with name FILENAME_rpc.txt,

where FILENAME.tif is the image name. If the file is found, the RPC available in it are input; otherwise the image is processed using generic (DLT) algorithm.

- **Quick Bird** – (61cm resolution for pan-chromatic imagery and 2.44m for multispectral). The system allows to process **Basic**, **Standard Ortho Ready** and **Standard** levels of imagery in TIFF or GeoTIFF formats. See the chapter 7.1.1 Space borne images adding.

7.1.1.3. *Working with images larger than 4GB*

In many cases raster files created when adding scanner images may become larger than 4 GB in size. Special file format - PRF (PHOTOMOD Raster File) - was developed to store and process such rasters. This format may be chosen in the dialog for saving scanner images being added. Choosing this format makes enabled the **Parameters** button, pushing which bring up the following dialog:



Maximal size of raster files - this parameter sets the maximum size of fragments into which the raster over 4 GB is split.

Use LZW compression - this option enables lossless compression (LZW) for the raster. It is recommended to turn this option on especially when the image contains (background) areas with constant brightness and color (usually black).

Pyramid part of original image - to speedup display in small zoom, along with the fragments, a general pyramid image is saved starting with the given zoom level. This option allows changing the starting zoom level of the pyramid.

7.2. *Creating Regions of Interest*

7.2.1. Regions of Interest by default

Mosaic is build by transformation of initial images. Image area, which is supposed to be included into mosaic, is called ***region of interest*** (ROI) and its boundary – ***cutline***.

Each source image has a rectangular region of interest (ROI) by default. This area excludes 10% of the image from each side just to make sure to avoid areas with *fiducial marks* from the output mosaic. Use the option **Trim off images edges** on **General** tab of **Preferences** window to setup the area to be cut off, see the chapter 6.5 Preferences. You can change the size of this rectangular ROI by using menu command **ROI's | Trim off images edges** or by pushing the icon (**Trim off images edges**) or by drag-and-drop the green cutline on the image.

If you are not going to create more complex cutlines (for example based on the rules of the classic photogrammetry) you can just start mosaic or preview building using these default ROIs. The images order in the output mosaic (which image is lower or upper in the overlapping area) is defined by the order selected in the window opened by the icon (**Images order**) (see the chapter 8.2.4 Additional recommendations). The source rectangles

may be converted to 4-corner polygons using menu command **ROIs | Polygon ⇔ rectangle** (see the chapter 7.3 Single image window). After that ROI become available for editing as described in the chapter 7.2.3 Creating and editing regions of interest.

7.2.2. Cutlines creating rules

Cutlines are boundaries of **Regions of interest** – areas on the source images used to be transformed and merged to the output mosaic. It is recommended to draw cutlines manually to improve mosaic quality, considering the following rules.

1. Draw ROIs as close as possible to the image principal point to increase geometrical accuracy of images matching.

2. If orthophotos are used as initial images, make sure that cutlines do not intersect the objects which are considerably towering over the relief (bridges, tall buildings, power lines piers etc.). Otherwise the objects could furcate or partially disappear from the mosaic.

3. Cutlines should not go along the extended objects with brightness different from the main background (forest area boundary, road etc.). Otherwise the edge smearing effect occurs on the object boundary if the option **Seams feathering** is **ON**. It is recommended either to intersect such objects on the right angle or draw the cutline on some distance (not less than one and a half **interpolation cell size**, in pixels) from the boundary.

4. Re-draw the cutlines over alternating areas on the image with different color, or draw it in parallel with the objects boundary but on some distance from it, to avoid abnormally bright areas on the output mosaic when local adjustment option is **ON** (see p.3).

5. The local adjustment works in such a way that images of each strip are adjusted first, and on the second step the strips are inter-adjusted. So the best situation is when ROIs borders inside every strip are “continuous” and the strips have some overlapping area. See also the chapter 8.2.4 Additional recommendations.

7.2.3. Creating and editing Regions of Interest

Usually ROIs are created on each source image loading one by one. It is convenient to have on the screen two-three windows with adjacent images of the source block (see the chapter 6.2 Images). To view a block fragment “around” the current image, open block scheme using the command **Window | Block scheme** or by clicking main panel icon (see the chapter 6.7 Block scheme).

ROIs are created using *cutlines editor* which opens by the icon or command **ROI | ROIs editor**. While adding ROIs you should create them with overlap to avoid “holes” on the output mosaic. For this purpose it is useful to see ROIs from adjacent images on the current one (icon **Show ROIs** of the main panel, or **Alt-Z** hot keys).

At that, the images order in the overlapping areas on resulting mosaic (upper-lower) corresponds to the sequence, preset in **Images order** table (opens by the icon of the main panel). ROIs of images, located above the current image, are hatched (see the chapter 8.2.4 Additional recommendations).

If the hatched ROIs from the adjacent images are shown on the current image, you should draw the cutlines precisely (considering terrain features, local brightness, buildings, etc.) on

the areas without hatching. But you can continue the cutline “under” the hatched areas schematically, keeping only the overlapping with the adjacent ROI.

During transformation of overlapping ROIs into cutlines the algorithm of “holes” finding between cutlines is working. If such “hole” is found, you get the warning and this area is shown by red hatching on preview image if the option **Fill holes between cutlines** is **ON** (**Service | Preferences** menu command, **General** tab).

Push the button **ROIs editor** (or click menu command **ROIs | ROI’s editor**) to open a panel with the following simple vector editing tools used for creating polygons:

- (duplicated by **Insert** key) - adds ROI (starting ROI creation)
- - removes ROI
- (duplicated by **S** key or double mouse click) - selects ROI
- - unselects ROI
- (duplicated by **Insert** key) - adds new vertex to ROI. In case of selected ROI inserts a vertex “between” two closest ones. In case of creating ROI add a new vertex
- (duplicated by **Delete** key) - deletes selected vertex
- (duplicated by single mouse click) - selects vertex
- - unselects vertex

- To move a vertex, select it and move by left mouse button holding down the **Ctrl** key.

The last group of icons is used to assign the following properties to the ROI:

- - region of interest - the default mode: the ROI is included to the mosaic
- - transparent ROI. Portions from other images, that are visible “through” the current one in accordance with the images order defined in the window opened by the **Images order** icon ( )
- - background ROI. A “hole” in the output mosaic colored by background color (selected in **Mosaic | Parameters | Mosaic** window).

It is convenient to use mouse settings when working with ROI (see the chapter 8.4 Preferences). For example it is easier to push right or middle mouse button instead of **Insert** key on the keyboard.

For editing and creating of ROI you may use **marker=mouse** mode (which is turned on by pushing the icon , located on the upper button menu, or by **F4** key). After that the marker on the screen becomes invisible and all mouse moves result in appropriate marker moves without additional clicks of mouse buttons.

For convenient work during ROI's creating you can use context menu commands (appeared after right mouse click over the image window), which duplicate above mentioned procedures with ROI.

When editing cutlines you may select group of cutline's vertices by mouse drag along with pressed **Shift** key, and also move the selected group by mouse along with pressed **Ctrl** key. Press **Esc** key to cancel vertices selection.

7.2.4. Tie points search and edit

If it is necessary to superpose ROI's from adjacent images more precisely you can find and measure tie points located near cutlines. Tie points could be measured both manually and automatically. Search and edit tools for tie points are located in the window opened by menu command **Mosaic | Tie points**, or by the icon in upper button bar.

You can measure tie points along cutlines in automatic mode first, by pushing the button **Search tie points in automatic mode**. After that tie points are displayed on the images and their coordinates are shown in the list. Click tie point on the image and its coordinates will be highlighted in the list of measured points. Double click on the raw of coordinates of the point selected, places marker on this point in the image window.

Then you can view tie points and if automatic search results are unacceptable and there is big divergence of terrain contours near cutlines in preview window, you may measure ties manually in the following way:

- In preview window with cutlines shown, place the marker on the cutline in area of terrain lines divergence.
- Open window of tie points search and push the button **Center images around marker**. After that windows with images, where the point should be measured, open and markers in them are placed approximately on the point.
- Place markers precisely on the measured point in images windows.
- Push the button **Add point** or **Add point with correlation**, to measure the point.

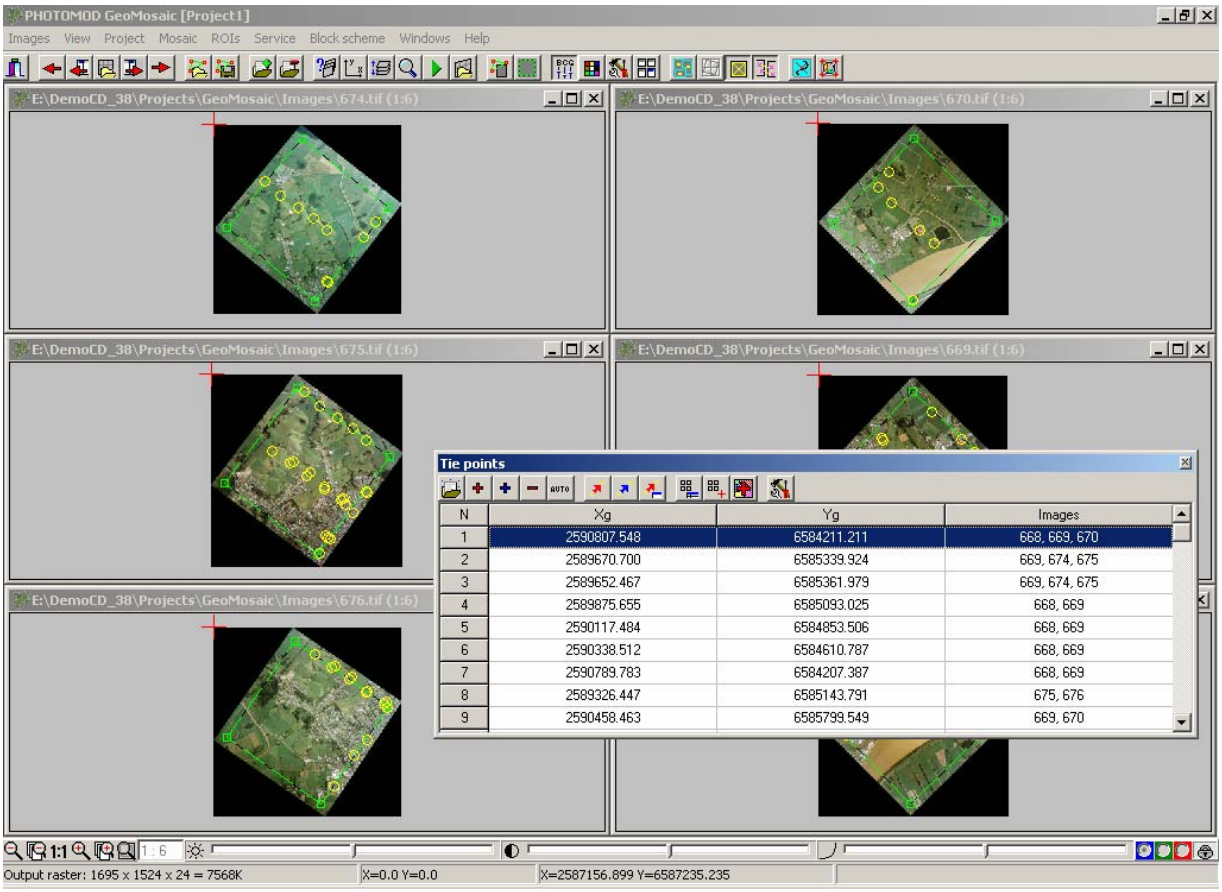


Fig.14 Tie points search results

Tie points search on the images is provided, using the following options of upper button bar:

- **delete all points** – deletes all tie points from images and their measurements from the list

- **add point** – when tie point is indicated on pair of images manually, it will be measured and added to the list after pushing this button

- **add point with correlation** – when measuring tie points on overlapped pair of images, the point is measured and added to the list if the correlation between two points is acceptable, i.e. suits the value indicated in **Min. correlation coefficient** field in **Tie points search parameters** window

- **delete point** – deletes tie point from the list and images

- **search tie points in automatic mode** – starts tie points search on overlapped images

- **re-measure all** – re-measure coordinates of existing tie point on all images, where it is already measured

- **re-measure all with correlation** – re-measure coordinates of existing tie point on all images, where it is already measured, more precisely using correlation algorithm. Its parameters are indicated in **Min. correlation coefficient** field in **Tie points search parameters** window

- **re-measure in active window** – re-measure coordinates of existing tie point just on the active image

- **center images around point** – places the window with image (or images) to put the point, selected in the list, into the window center

- **center images around marker** – opens images windows, where you need to measure point, and markers in these windows are approximately placed into the point's area

- **build mosaic fragment around active point** – creates small fragment of mosaic with size (width and height in pixels), defined in **Mosaic fragment** panel in **Tie points search parameters** window, see description below

- **parameters** – opens the window for setup parameters of automatic tie point search:

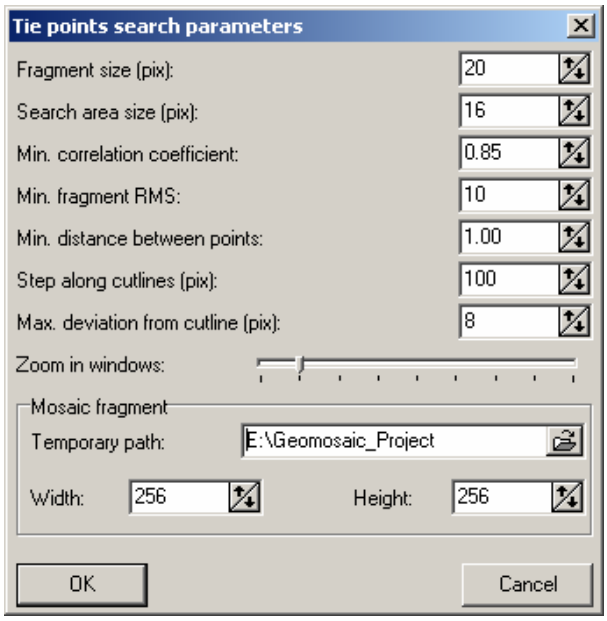


Fig.15 Tie points search parameters

- **Fragment size (pix)** – size of mosaic fragments, built using current settings of **PHOTOMOD GeoMosaic** (pixel size, etc.)
- **Search area size (pix)** – maximal supposed size of mutual discrepancy used for search.
- **Min. correlation coefficient** – minimal value of correlation function, under which fragments from adjacent images are considered of the same name.
- **Min. fragment RMS** – minimal value of RMS of fragments brightness, under which the fragments are considered as nonhomogeneous background (water surface, etc.), i.e. suitable for comparison.
- **Min. distance between points** – minimal distance between fragments to be compared located on the adjacent cutlines.
- **Step along cutlines (pix)** – step along cutlines in pixels. The less the value the more points are included to the report, but the more time is consumed for search.
- **Max. deviation from cutline (pix)** – maximal deviation of tie point found from cutline.
- **Zoom in windows** – zoom scale used for viewing of tie points in windows when select them in the table.
- **Temporary path** – target folder used to save mosaic fragment built around given point.
- **Width** and **Height** – size of a fragment around given point in pixels.

Tie points found are used for resulting mosaic building if the option **Use tie points** on **Mosaic** tab in **Parameters** window is **on**, see the chapter 8.1 Mosaic.

7.2.5. Regions of Interest import and export

You can import regions of interest from vector files in Shape and DXF formats (by menu command **ROIs | Import ROI's**). Regions of interest are created on the initial images and stored in pixel coordinates system.
The main task during the import is image selecting for correct ROI's referencing. ROI's referencing parameters are set up in the window opened by menu command **ROIs | Import ROI's | Import from DXF/Import from Shape**.

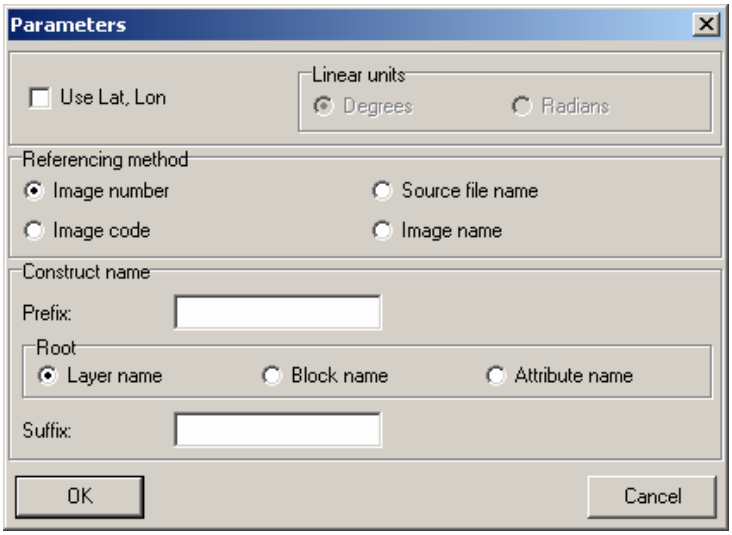


Fig.16

After import regions of interest are referenced to mosaic using the following options:

- **Image number** – number of image in GeoMosaic project. It is taken from initial order of images in **Open images** window just after **PHOTOMOD GeoMosaic** opening.
- **Layer number** – image number, in its order of including to mosaic i.e. its number in **Images order** window, see the chapter 8.2.4 Additional recommendations.
- **Source file name** – file name (with extension), which is used at PHOTOMOD GeoMosaic project creation.
- **Image name** – initial file name without extension.

Import from DXF format

In DXF file root of name could be stored as layer name, block name or attribute name. Besides, you can add a **prefix** to this name in the beginning, and/or **suffix** in the end.

Import from Shapefile format

In this format georeference information is storing in separate file with dbf extension. The only one raw from dbf table corresponds to each vector object. Select the column before import, to use its values as a name root. Then you can add prefix and/or suffix to the name.

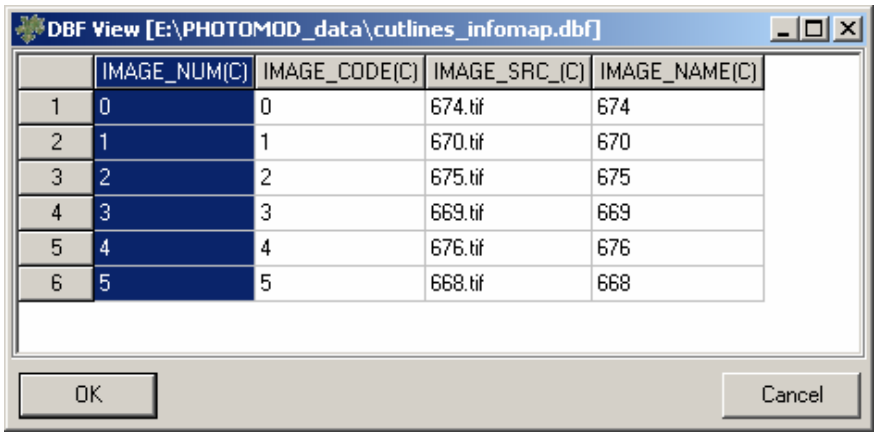


Fig.17

If the ROIs coordinates are stored in geographic coordinate system (latitude, longitude) turn ON the option **Use Lat, Lon** and select necessary units (degrees or radians).

After import completing a message about images number and referenced ROI's appears.

Export ROI's to files

Regions of interest and cutlines could be exported to DXF, Shapefile and MIF/MID formats using menu command **ROIs | Export ROI's** or **ROIs | Export cutlines**.

If you need to reference ROI's to coordinate system with latitude and longitude axes and degrees or radians units after export, turn on the option **Use Lat, Lon** for their correct export and then select appropriate **Linear units**.

During export of ROI's or cutlines into MIF/MID format the name of image which contains a cutline is exported to NAME attribute, that allows to show it in the attribute's table in MapInfo software after cutlines opening in it.

7.3. *Single image window*

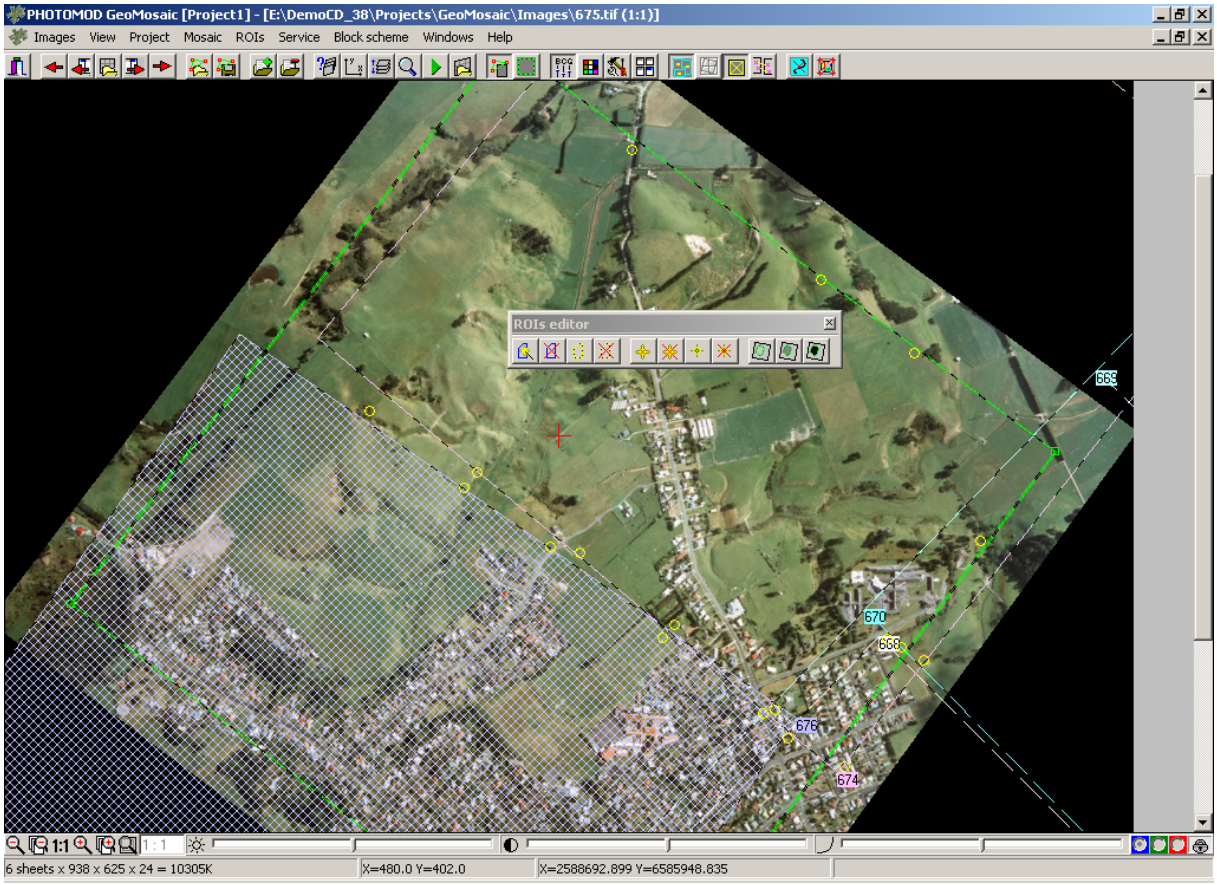


Fig.18 Single image window

At the lower part of the window there are standard icons for displaying raster image:

- - one step zooming out (duplicated by "*/*" key)
- - one step zooming out (duplicated by "*/*" key) for all images opened
- - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by **Alt-1** shortcut)
- - one step zooming in (duplicated by "*" key)
- - one step zooming in (duplicated by "*" key) for all images opened
- - fitting the whole image into the window (duplicated by **Alt-Enter** shortcut)
- - fitting the whole image into the window for all images opened in block scheme (duplicated by **Alt-Shift-Enter** shortcut)

Current image zoom is shown in title bar in brackets after image name and in the lower part of the window as .

You can also use following key combinations to zoom arbitrary image fragment or move it:

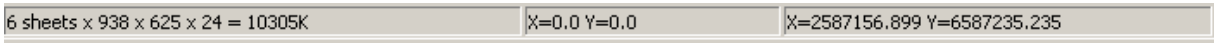
- **Ctrl + Alt + mouse** zooming in by zoom box, "drawn" by mouse
- **Ctrl + Alt + Shift + mouse** zooming out by zoom box
- **Alt + mouse** panning the image
- **Mouse wheel** mouse wheel steering allows to zoom in/zoom out image on the screen

Following sliders (, ,), located at the bottom of the window, are used to set up brightness, contrast and gamma respectively for the active image. When working with color images there is a possibility to adjust these radiometric parameters separately by channels (using the buttons). Right click any slider and select the option **Set original BCG correction** to restore BCG settings by default.

Note. These settings are memorized and used for output mosaic creation

When you create ROI (see the chapter 7.2.3 Creating and editing ROI) you can use the icon (duplicated by **Alt-Z** hot keys) to show/hide cutlines from the adjacent images on/from the current one. Each cutline is displayed by different color and is labeled by the corresponding image number. ROI's on images which are "above" the current image are shown by hatch.

The lower string of image window consists of three parts with information helpful to estimate the following values of resulting mosaic:



- Number of map sheets of resulting mosaic according to the selected parameters (see the chapter 10 Splitting mosaic into map sheets)
- Raster size of resulting mosaic in pixels (height and width)
- The last multiplier in this section is number of bits per pixel of mosaic to be created, 8 means that resulting image will be black and white (8-bit), number 24 shows that the mosaic will be color – 24-bit
- Mosaic volume in kilobytes, example on Fig.8 shows that mosaic will be approximately 10 Mb of volume
- XY coordinates of current cursor position on active image in pixel coordinates
- XY coordinates of current cursor position on active image in user (terrain) coordinates – you may copy these coordinates to the clipboard (by **Ctrl-C**) and paste them into selected application (by **Ctrl-V**).

7.4. *Raster image georeferencing*

Initial raster image (in TIFF, BMP, JPG, IMG, NTF, GIF, PNG, PIX, JP2 formats) could be georeferenced using ground control points coordinates in the following window opened by menu command **Service | Raster georeferencing…** or by pushing the button (**raster georeference**) in upper button bar.

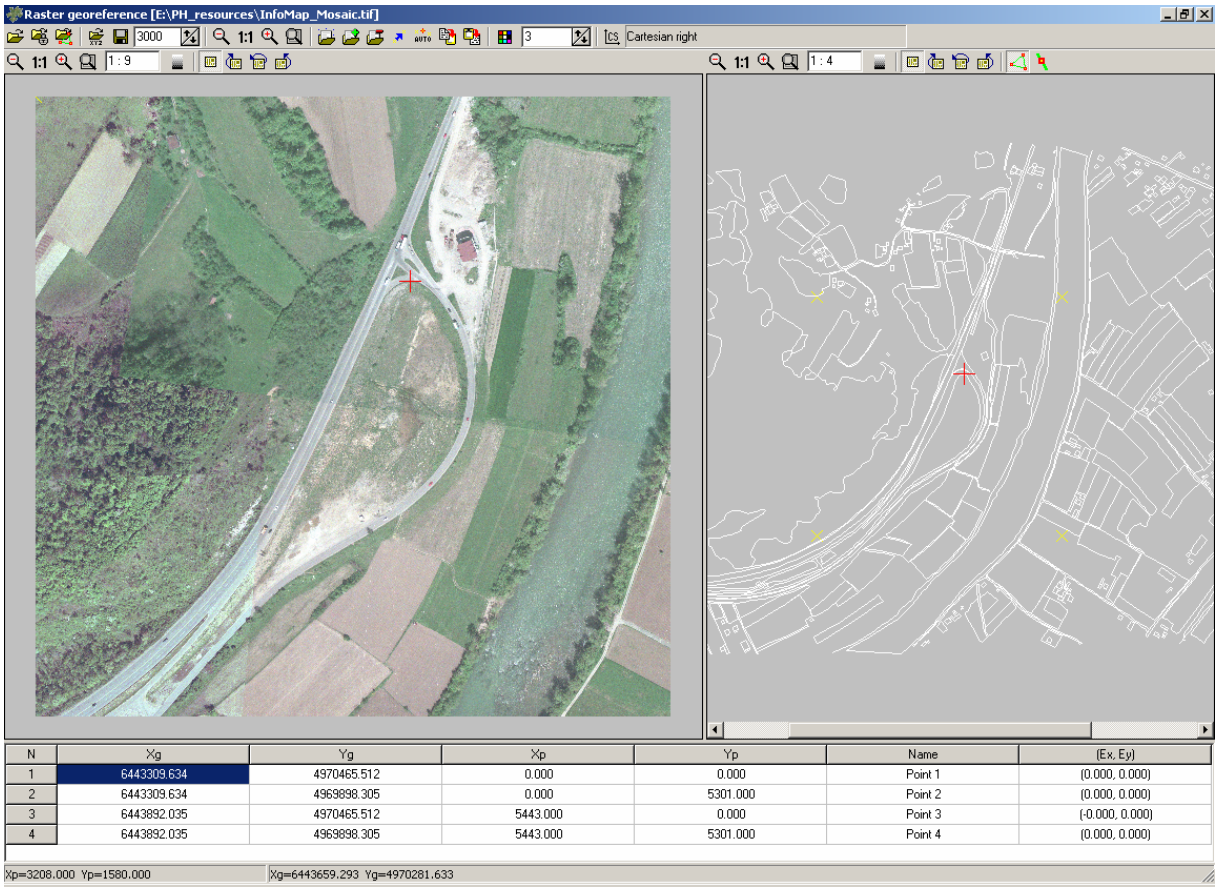


Fig.19 Raster map window

If georeference file (in MapInfo TAB format and with the same name as map file) is storing in the same folder as file with scanned map, then list of georeference points and their coordinates is opened in **Raster map** window. In this list Xg, Yg – geodetic coordinates, Xp, Yp – pixel coordinates, Name – point name.
To visualize point in map window (to place marker in point's pixel coordinates) you should push the button with point number in leftmost column **N** of the table.

Upper menu buttons are intended for the following operations:

(duplicated by hot keys **Ctrl-O**) - load raster map – opens dialogue to select raster file (in TIFF, BMP, JPG, IMG, NTF, GIF, PNG, PIX, JP2 formats) and open it

- load reference map – opens dialogue of raster file selection (in main raster formats) and its opening. This georeferenced raster allows to recognize points on un-referenced raster and measure their coordinates.

- load vector map – opens dialogue of vector format file selection (PHR (PHOTOMOD system format), DXF, Shape or DGN). This file allows to recognize points on un-referenced raster and measure their coordinates.

- load XYZ points from file – opens dialogue used for selection of text file of CSV format, which contains reference points coordinates, and settings for points import from the file. After import points' coordinates are opened as a table below the map window. Point's coordinates could be loaded replacing opened coordinates (if the option **Clear before import** is on) or in addition to them (if the option is off).

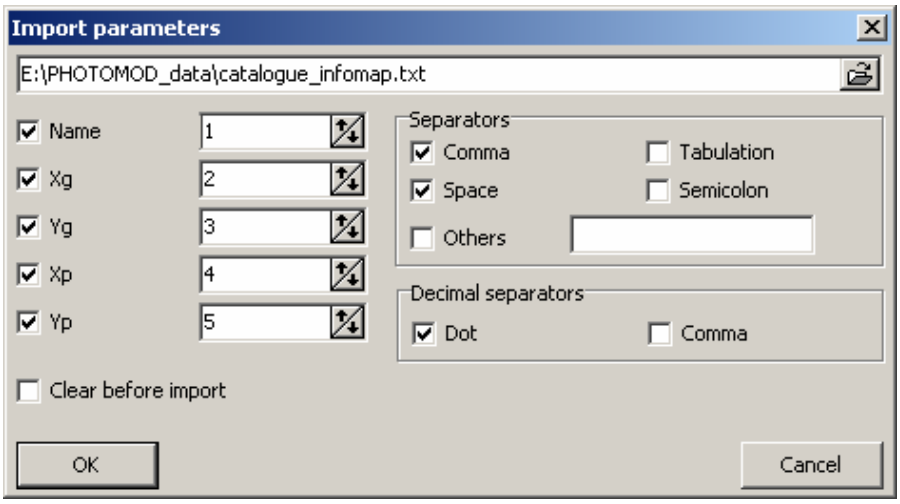


Fig.20 Settings of import of reference points coordinates from CSV file

- allows to manage the scale of vectors in the window

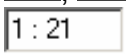
- show vectors – hides/shows vector objects over raster map if vector file is opened

- show vertices – hides/shows vertices of vector objects if vector file is opened

- save – saves georeferencing file in MapInfo TAB format, with the same file name as map file name, but with TAB extension.

,

, , - zoom management, duplicated by hot keys - **/**, **Alt-1**, ***, **Alt-Enter**



- shows zoom scale in raster map window

- map displaying in grayscale or color mode.

For more convenient work the map could be rotated in the following ways: - without rotation, - turn at 90 degrees, - turn at 180 degrees and - turn at 270 degrees. At that raster file is not changed and the rotation is executed “on fly”.

- clear – deletes all points (list cleanup)

- add point – measures new point coordinates on the map and adds them to the end of list. At that marker pixel coordinates will be assigned to point and to geodetic coordinates will be assigned 0 value (you can input them manually in appropriate cell)

(duplicated by hot keys **Ctrl-Del**) - delete point – deletes the point selected in list

- re-measure – replaces pixel coordinates of selected point. At that current pixel coordinates of marker are assigned to point and saved in the list

- Auto-place – places marker to coordinates of point selected in list

- copy coordinates to clipboard – copies coordinates of selected point to clipboard. Coordinates are in the following format "Xp Yp Xg Yg"

- paste coordinates from clipboard – pastes selected point coordinates from the clipboard in following possible formats: "Xg Yg", "Xg Yg Zg", "Xp Yp Xg Yg", "Xp Yp Zp Xg Yg Zg", where Zp equals 0.

- select color – opens standard OS Windows palette to choose point’s symbol color on the map

- decimal places – allows to input number of decimal places in coordinates of reference points

- coordinate system – shows current coordinate system, and the left button opens a window used for coordinate system change, see the chapter 16 Coordinate systems.

For map georeferencing you should recognize on the map points with known geodetic coordinates. Map could be referenced using only one point (in that case it is considered that measurement unit is 1 pixel and axes coincide. If there are two points, then map will be scaled and rotated, in case of three points affine transformation will be applied), but for accuracy control you should measure not less then 4 points.

To measure point put marker on point's place on the map and push button (add point). After that point's name and pixel coordinates will be added to the list. Input geodetic coordinates of the point to appropriate cells manually. When fifth point is measured, coordinates measurement errors E_X and E_Y are automatically calculated and saved to the last columns.

To place marker on the measured point on the image, click the table cell with point number (in leftmost column).
To edit coordinate value in table cell, select the cell and press **F2**. To end editing and save coordinate press **Enter**, to exit from editing without coordinate saving press **Esc**.

When raster image referencing is completed, push the button to save georeference file in MapInfo format.

7.5. *Images referencing*

For more accurate linking of initial images during mosaicking use images referencing operation in the window, opened by pushing the button (**images referencing**) in upper button bar or by the command **Service | Images referencing**.

The window allows to associate images, which are not referenced to coordinate system and may be linked only to each other (unlike to rasters georeferencing, performed in the appropriate window, see the chapter 7.4 Raster image georeferencing) manually by identifying the same points on the adjacent images. The images located "upper-lower" to each other should be placed to the "strips" and linked to each other either.

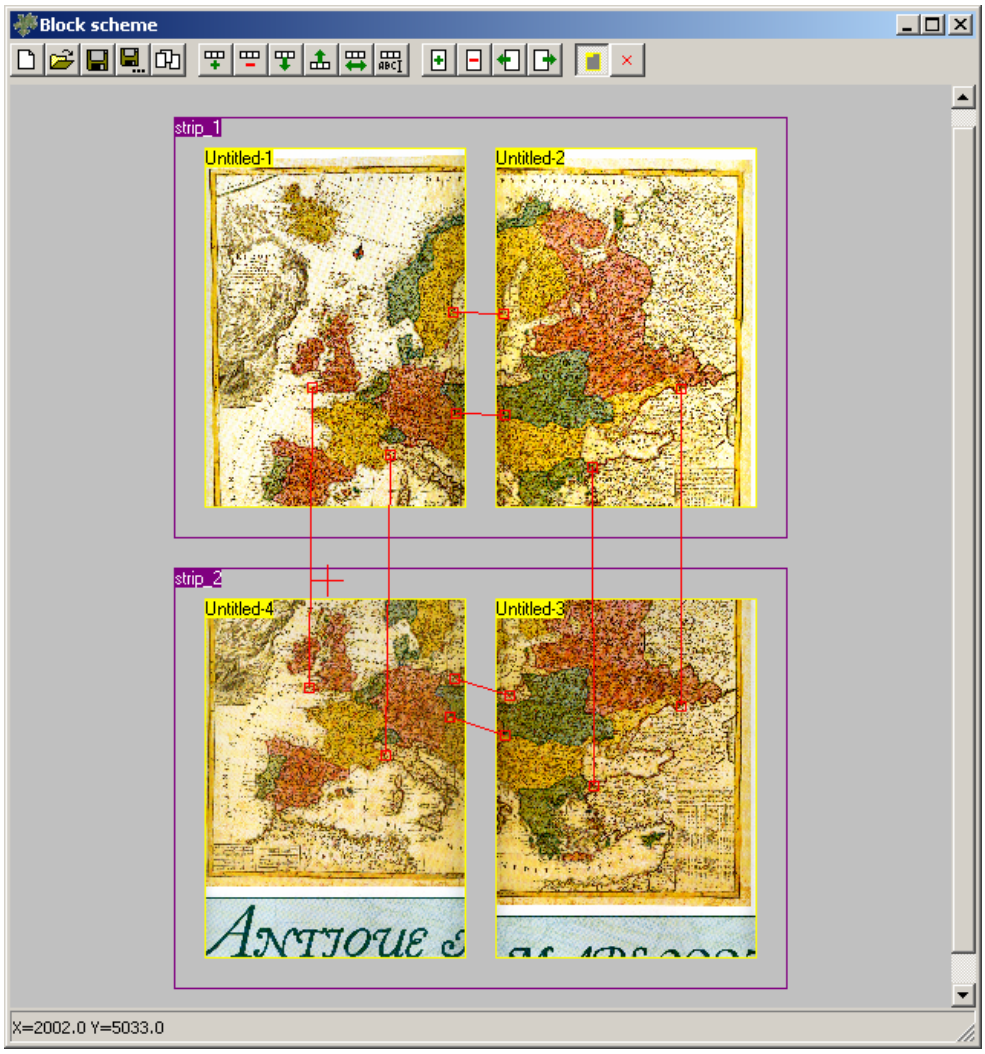


Fig.21 **Block scheme** window for images referencing

Open new strip in this window (by pushing the button **add strip**), then add images to this strip (by pushing the button **add image**). Add all strips and images, place them in needed order using moving tools along with pushed button (**images moving mode**).

Then it is possible to reference them manually in the following way: indicate the appropriate points on the images by the mouse cursor and press the **Insert** key. To place the cursor accurately on the well-recognized points of the image use mouse along with pressed **Ctrl** key and pushed button **vertices moving mode**. To zoom in/out the image in **Block scheme** window use hot keys */* and ***** on keypad (or mouse wheel turn). For image panning use mouse move along with pressed **Alt** key.

When strips and images are linked to each other, push the button **save reference**, to save the links into files with tab extension for each image. After that close the **Block scheme** window and in main **PHOTOMOD GeoMosaic** window add the images into mosaic project.

Then you can perform usual procedure of preview and mosaic creation.

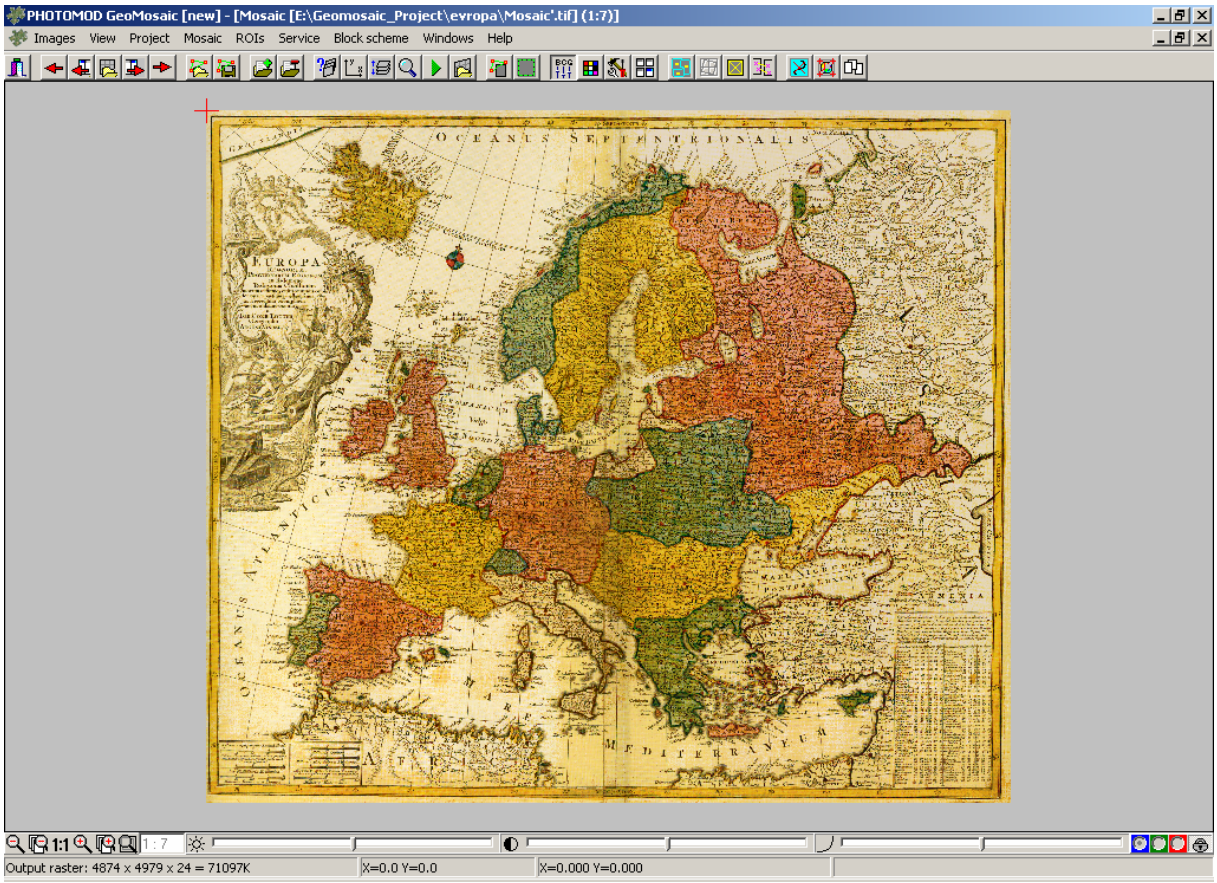

PHOTOMOD GeoMosaic [new] - [Mosaic [E:\Geomosaic_Project\evropa\Mosaic'.tif] (1:7)]
Images View Project Mosaic ROIs Service Block scheme Windows Help
OCEANUS SEPTENTRIONALIS
EUROPA
OCEANUS ATLANTICUS
MEDITERRANEUM
Output raster: 4874 x 4979 x 24 = 71097K
X=0.0 Y=0.0
X=0.000 Y=0.000

Fig.22 Image, merged using manual links created in **Block scheme** window

Note. If sheets of images to be merged have no overlap (adjacent sheets of topographic maps, for instance), you should link them to each other just in one point that can be, for instance, common node of grid

Set of files with manual reference could be saved into **Block scheme** project (file with *.sch extension) by pushing the button (**save project**) or (**save project as**). Push the button (**open project**) to open the project or the button (**new project**) to create a new one.

8. Parameters and preferences

Use the icon or menu command **Mosaic | Parameters** to open **Parameters** dialog consisting of the following tabs:

8.1. *Mosaic*

Mosaic tab is used to set up the following parameters:

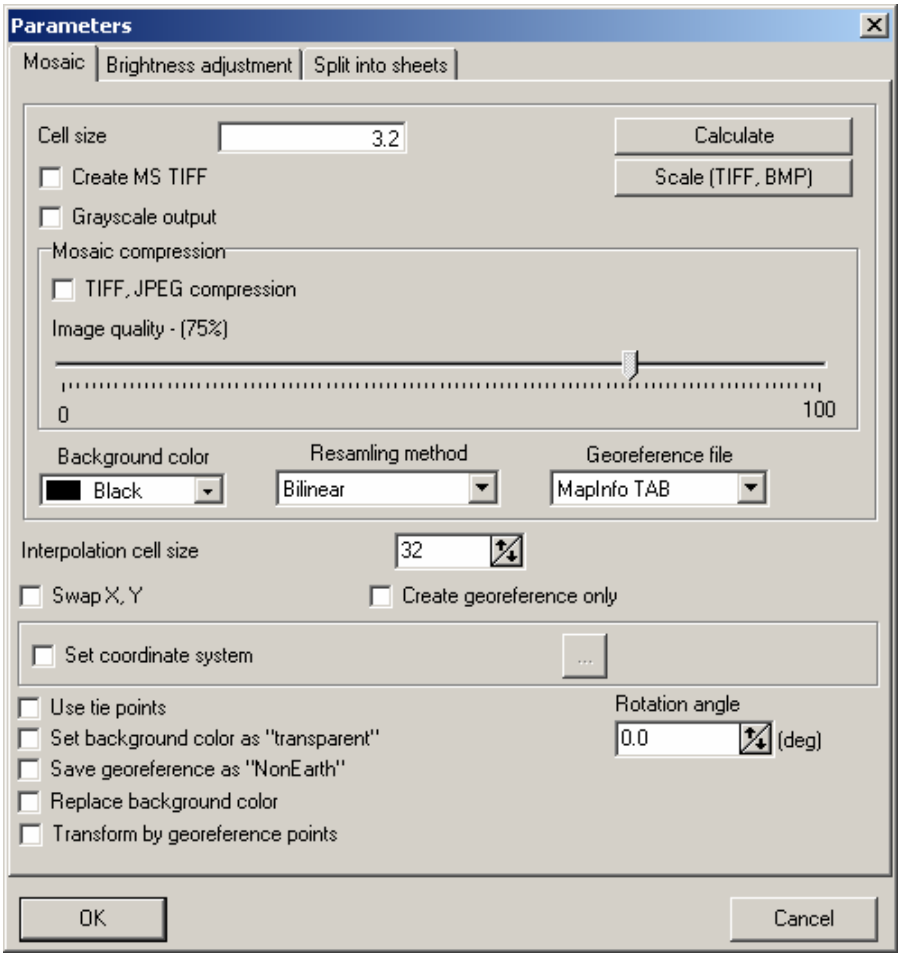


Fig.23

- **Cell size** – this text field is used to enter the size of mosaic cell on the ground. This parameter is specified in units shown in brackets. The cell size by default is equal to the cell size of the first image of mosaic project. The **Calculate** button opens a dialog used to set a mosaic size in pixels and recalculate its cell size accordingly. The **Scale (TIFF, BMP)** button opens a dialog used to calculate print size and resolution according to the resulting mosaic scale input by the user.
- **Create MS TIFF** – used to build a pyramid image of output mosaic inside TIFF or GeoTIFF file, that allows to speed up the image zooming.
- **Grayscale output** – this check box is active only when at least one of the original images is an RGB one. Mark it to create the output mosaic as grayscale image.
- Options in the **Mosaic compression** panel are used to compress the output mosaic image. Check the **TIFF, JPEG compression** box and use the slider **Image quality (0-100%)** if you want to apply the compression. The default value of compression is 75% (usually it causes the 5-7 times compression of initial image volume).

- **Background color** – used to set a color for mosaic background (since it always inscribes into a rectangular raster). Following options of background color are provided: **Black**, **White**, **Other** (the last one opens standard OS Windows dialog of color selection). In case of grayscale output selected color is replaced by corresponding grayscale value (with the same intensity).
- **Resampling method** – allows to choose brightness interpolation mode for orthomosaic creation: bilinear, cubic and nearest neighbor.
- **Georeference file** – allows to select the format of the additional file created along with output mosaic and containing the information for mosaic referencing to coordinate system. See the chapter 15 Georeference file.
- **Interpolation cell size** – in **PHOTOMOD GeoMosaic** the output raster is created as a sequence of tiles. The size of each processing tile is defined by the parameter “interpolation cell size”. The larger the tile the faster and less accurate is mosaicking process. Recommended tile size is about 20-40 pixels. Default value is 32.
- **Swap X, Y** – X,Y coordinates in resulting mosaic could be swapped if necessary
- **Create georeference only** – allows to create just georeference file without building the mosaic. It is saved to the path selected into file format indicated in the **Georeference file** drop-down list.
- **Set coordinate system** – allows to change the initial coordinate system for resulting mosaic if necessary (see the chapter 14 Coordinate system transformation).
- **Use tie points** – for more precise images (ROI’s) superposition on cutlines for mosaic building, use tie points measurements, performed both automatically and manually (see the chapter 7.2.4 Tie points search and edit).
- **Set background color as “transparent”** – when saving the resulting mosaic in MapInfo format (selected in the **Georeference file** drop-down list), you can set the background color which is shown in MapInfo system, as transparent
- **Save georeference as "NonEarth"** – when saving the resulting mosaic in MapInfo format (selected in **Georeference file** drop-down list), allows you to save georeference as NonEarth coordinate system. Used if MapInfo system does not support coordinate system of **PHOTOMOD GeoMosaic** project.
- **Replace background color** – allows to change color of pixels located inside mosaic image to avoid pixels on output image with the same color as its background
- **Transform by georeference points** – allows to transform the initial image using georeference points. Georeference file should be in TAB format. The operation is used mainly for space images transformation. Images also could be referenced directly in **PHOTOMOD GeoMosaic** module, see the chapter 7.4 Raster image georeferencing
- **Rotation angle** – allows to rotate output mosaic. It is helpful when initial images block has elongated shape, and you need to cut unnecessary background in rectangle window of resulting mosaic.

8.2. *Brightness adjustment*

Brightness adjustment tab is used for radiometric correction of source images to produce seamless mosaic.

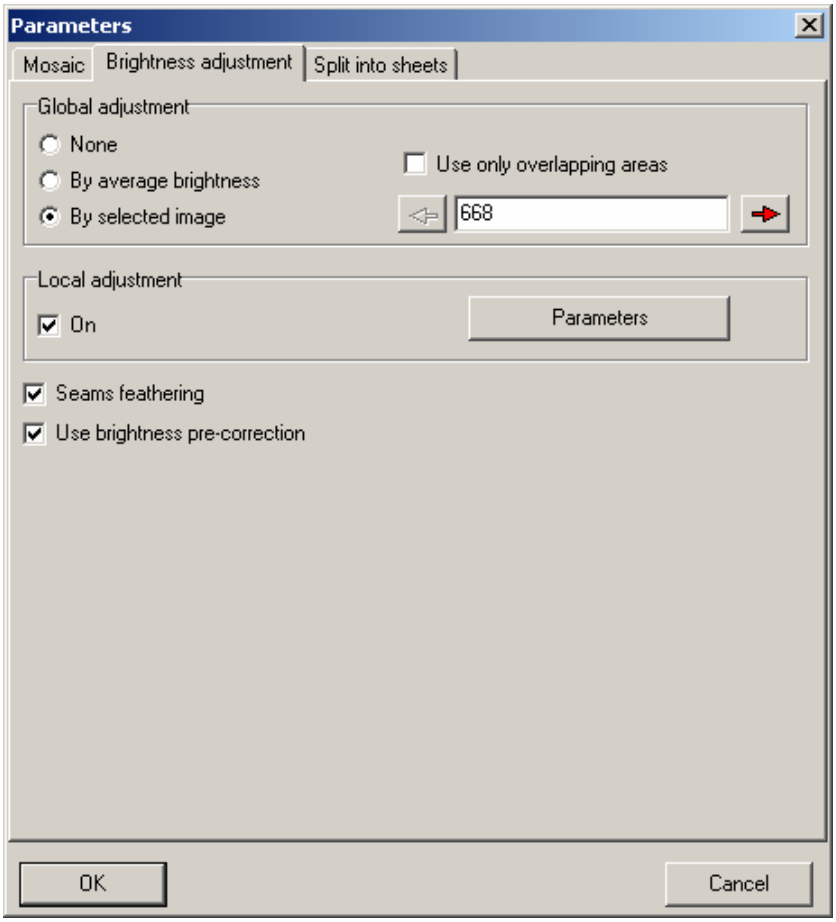


Fig.24 Brightness adjustment parameters

This panel allows to setup global brightness adjustment of resulting mosaic (see the chapter 8.2.1 Global brightness adjustment) and also local adjustment parameters (see the chapter 8.2.2 Local brightness adjustment).

Mark the option **Seams feathering** to smooth the seam between adjacent images in the narrow zone around. The size of smoothing zone is defined by the parameter **Interpolation cell size** (see the chapter 8.1 Mosaic).

You can include brightness-gamma-contrast adjustments done for initial images to resulting mosaic creation by marking the option **Use brightness pre-correction**.

8.2.1. Global brightness adjustment

The global adjustment (**Global adjustment** panel) allows to apply selected type of transformation to all pixels of each source image.

Select a brightness adjustment type from the following list:

- **None** – allows to use un-adjusted images
- **By average brightness** – brightness and contrast are adjusted basing on average values calculated over all mosaic images. This method is recommended when there are

big differences between brightness' of images, but each of them contains relatively smooth scenes. Thus in cases of scenes with sharp different brightness within one image (for example the sea and the coast) this method may produce incorrect results.

- **By selected image** – mosaic brightness and contrast are adjusted in accordance with corresponding parameters of selected ("reference") image. Use red arrow buttons for the image selection. Use the option **Use only overlapping areas** to consider only overlapping image areas for the brightness adjustment. In this case it is recommended to select an image from the middle part of the block as a "reference" one. However in case of abnormal brightness fluctuations ("trends") you can face a problem of smooth increasing, or reducing of the brightness from the reference image to the block edges. So it's not a recommended option for such kind of data.

8.2.2. Local brightness adjustment

The local adjustment of image brightness applies some brightness transformation along cutlines of images that are merged into mosaic with a smoothing going down to the image central point and mosaic edges. During this process the brightness (additive component) and contrast (multiplicative component) of initial images are changed at the same time. Use the **Local adjustment** panel on the **Brightness adjustment** tab on the **Parameters** window to setup the process parameters.

There are some suggestions for creating cutlines for local brightness adjustment. It is recommended to draw cutlines along the borders of uniform color objects but at some offset from it to avoid border blurring when using the **Seams feathering** option (see the chapter 8.2 Brightness adjustment). The offset size should be about one-two **Interpolation cell sizes** values (see the chapter 8.1 Mosaic), considering the ratio between source images and output mosaic scales. For example, interpolation cell size = 32, source image cell size = 0.17 m and the required mosaic cell size is 0.5 meters. The ratio between source and output scales is about 3, so you can draw a cutline at distance 3*32 = 100-200 pixels from the object edge.

Sometimes the local adjustment produces bad looking seams or small abnormal brightness or color spots close to seams. Change the cutline position to resolve the first problem. The color spots can be removed by adding "pins" inside them, while working with the image in the **Preview** window. So you should open the **Preview** window and put "pins" inside spot areas using **Insert** key. The pins are displayed by yellow circles and may be selected by mouse click, deselected by **Esc** key and deleted by **Delete** key.

Use menu command **View | Local adjustment** when **Preview** and **Mosaic** windows are opened to display areas, where statistical parameters are calculated. Areas between images of one strip are green, areas between images of separate strips are blue and areas inside single images are yellow. This information would help you to view and understand the reason of local brightness unevenness.

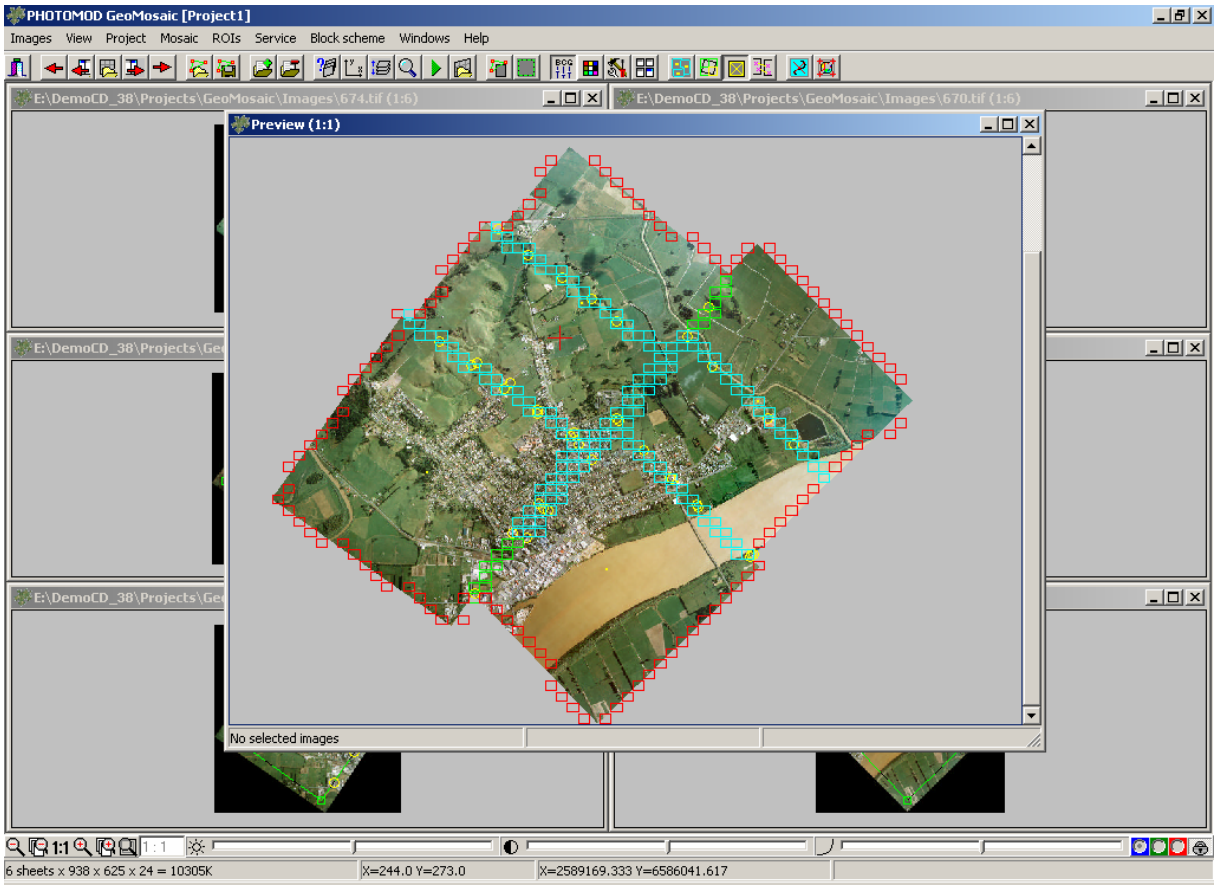

PHOTOMOD GeoMosaic [Project1]
Images View Project Mosaic ROIs Service Block scheme Windows Help
Preview (1:1)
No selected images
6 sheets x 938 x 625 x 24 = 10305K
X=244.0 Y=273.0
X=2589169.333 Y=6586041.617

Fig.25 Local brightness adjustment in preview window

Local brightness parameters (the **Parameters** button) are adjusted in appropriate window on two tabs: **Base** – contains parameters influencing on brightness insight images and between them, and **Edges** – contains parameters influencing on brightness of external mosaic border.

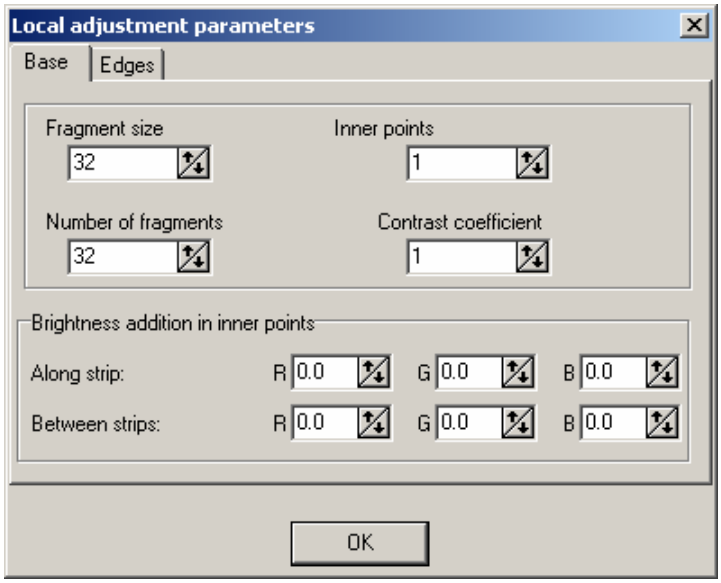


Fig.26 **Base** local adjustment parameters

On **Base** tab:

- **Fragment size** – a size of image fragments of the same name, used to create a model of local brightness adjustment. The bigger fragment size the better adjustment but the slower processing.

- **Number of fragments** – number of fragments of the same name, located on each image. The greater the number the better adjustment, but the slower the process of parameters calculation and mosaic creation.
- **Number of inner points** – sets the number of points inside the image and on the edges of output mosaic, where the brightness should be preserved. Lack of inner points leads to brightness anomalies when moving away from the cutlines. Excess number of inner points causes the brightness un-adjustment along the cutlines.
- **Contrast coefficient** – in some cases when the contrast of initial images was defined incorrectly it causes poor brightness adjustment or errors in creating of local brightness adjustment model. You can increase the value of this parameter up to 7 to improve the result.
- **Brightness addition in inner points** – allows to setup brightness (separately by R, G, B channels) in inner points either along the strip and/or between the strips. It is recommended to use this parameter in case of considerable brightness change from image center to its sides, which is impossible to remove by another way. At that the **Inner points** parameter should be not more than 1-2.

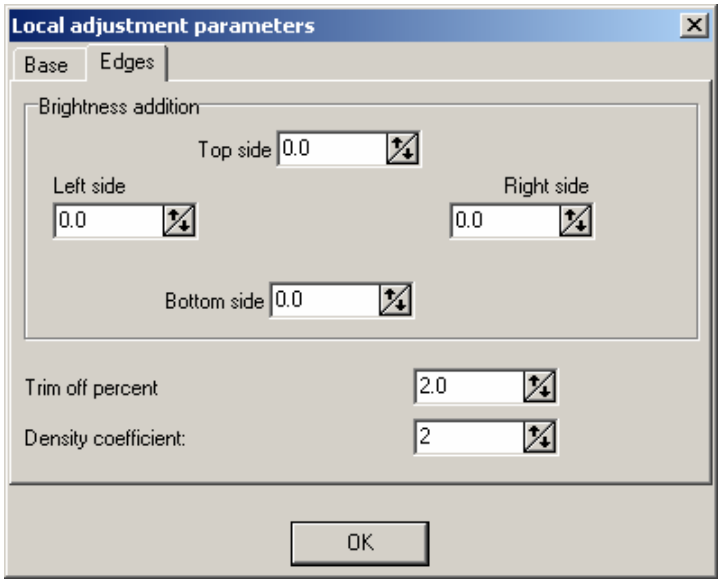


Fig.27 Brightness parameters on mosaic edges

Edges tab contains the following parameters:

- **Brightness addition** – allows to setup smooth brightness change on 4 sides of output mosaic. Color imbalance on mosaic sides is unnoticeable, that is why the brightness is changing in all spectral channels at the same time.
- **Trim off percent** – allows to exclude corresponding percent of image area along the mosaic sides from processing (because there are auxiliary signs, marks, etc.).
- **Density coefficient** – sets the amount of tie points on the edges of mosaic, which are used for adjustment. Lack of these points leads to brightness anomalies when moving away from the cutlines. Excess number of tie points causes the brightness un-adjustment along the cutlines.

Note. Changing these parameters is recommended just for experienced users

Note. Since local adjustment parameters depend on cut lines location, then any cutlines change results in recalculation of the parameters, when you start mosaic or preview building

Note. It is recommended to exclude each second image in every strip from the mosaic when using local brightness adjustment. Obviously it is necessary to have triple overlap (greater than 50 percent) between images in this case

If you get message **Interpolation model building error** during mosaic creation, it means that local brightness adjustment has been done incorrectly and you should change the **Contrast coefficient** parameter, as described above or correct cutlines manually.

8.2.3. Building strips

The set of initial images should be organized into strips for correct local brightness adjustment and automatic building of regions of interest. **GeoMosaic** program includes strips building option which uses analysis of mutual images placement.

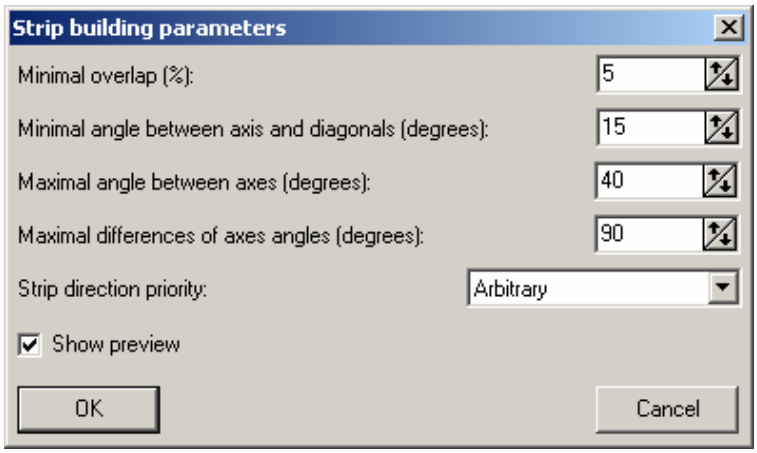


Fig.28 Strip building parameters

Menu command **Block scheme | Build strips** opens the window where you can setup the following parameters of strips creation:

- **Minimal overlap** between images. The less the parameter, the less overlap area is allowed between the images in the strip.
- **Minimal angle between axes and diagonals**
- **Maximal angle between axes**
- **Maximal differences of axis angles**
- **Priority strips direct** may be horizontal, vertical and arbitrary

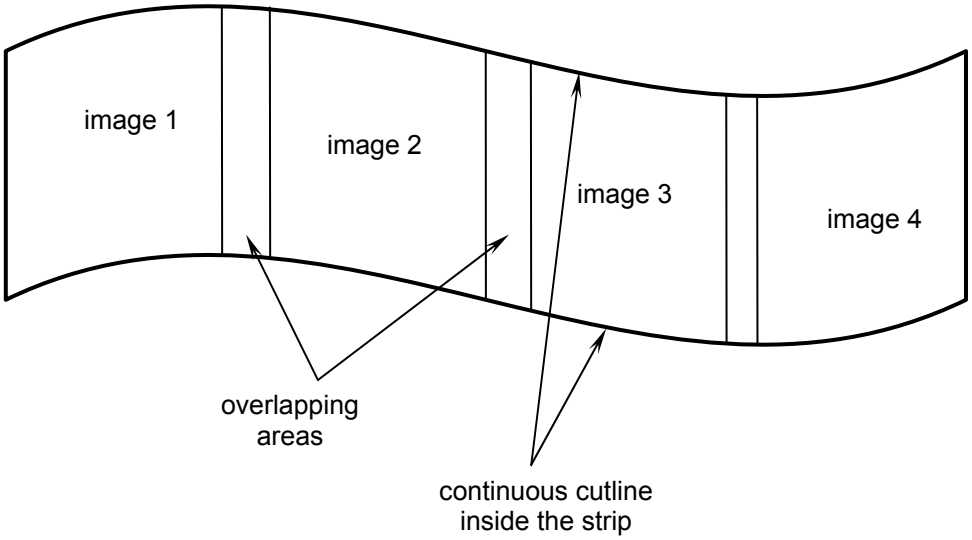
It is recommended to change these parameters only when the strips are created incorrectly.

You can view created strips in preview window as lines joining centers of images included to the same strip (the option **Show preview** should be ON).

8.2.4. Additional recommendations

In most cases the local brightness adjustment procedure provides satisfactory results. But if you want the algorithm to work ideally, draw the cut lines as described below.

The local adjustment works in such a way that images of each strip are adjusted first and on the second step the strips are inter-adjusted. So the best situation is when ROIs borders inside every strip are “continuous” as it is showed on the picture.



Then the strips are adjusted with some overlapping area:

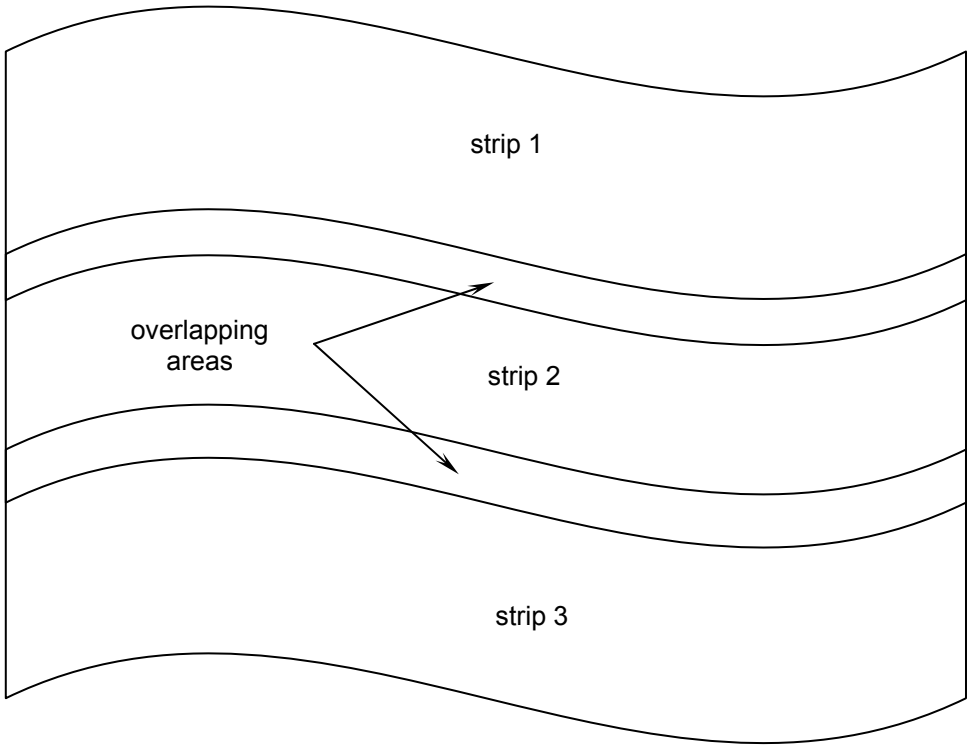


Fig.29

Moreover, you should pay attention on the order of images insight the strip – because ROIs taken from “upper” image are included to the resulting mosaic and their brightness is considered during brightness adjustment of the resulting mosaic.

For brightness adjustment of resulting mosaic it is enough to change images order, using menu command **Mosaic | Images order** (or the icon) which opens the **Images order** window.

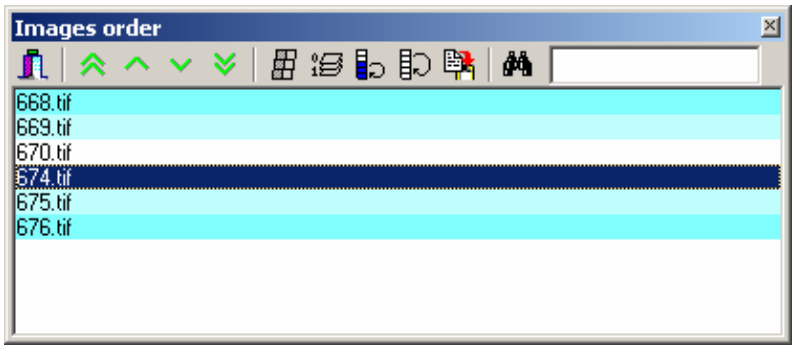


Fig.30 Images order change

The color in this table highlights the images of the same strip. You can move images in the list using the icons - **Upper**, - **Lower**, - **To top**, - **To bottom**, and select those to be included in resulting mosaic in overlapping area. It is convenient to use the following operations for work with images list:

- **select strip** – opens an additional window with the list of strips for selecting.
- **by images order** – restores the initial order of the images and cancels all changes.
- **invert order of selected images** – allows to sort selected images in the revert order.
- **invert order of all images** – allows to sort all images in the revert order.
- **copy to clipboard** – copies list of images names into clipboard in text format, allowing to paste them into text editor, send by e-mail, etc.
- **find** – starts image search in the list using its name after name input to search field.

Select image name by mouse click and group of images holding left mouse button along with **Ctrl** and **Shift** keys pressed. You can also move selected images names using buttons with arrows in this window, described above.

8.3. *Splitting into sheets*

Process of splitting output mosaic into map sheets is described in details in the chapter 10 Splitting mosaic into map sheets.

8.4. *Preferences*

Preferences window (Fig.31) opens using the icon of the main button bar or menu command **Service | Preferences**.

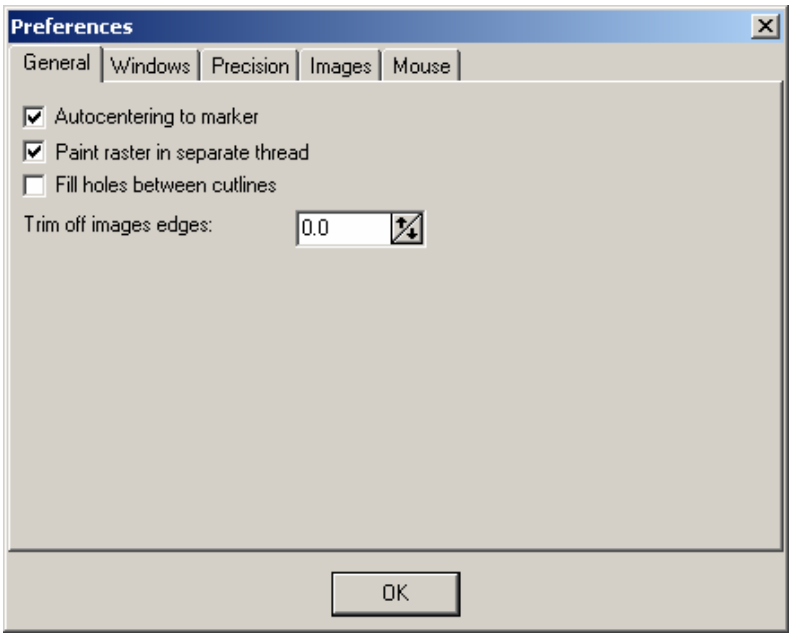


Fig.31

PHOTOMOD GeoMosaic preferences include the following tabs:

General:

- **Autocentering to marker** – automatically centers window into marker position on the image after zoom in/out
- **Paint raster in separate thread** – allows to output mosaic in separate thread. The visualization thus could be smoother but slower, with pre-loading of white background that is not convenient for panning. It is recommended to use this option, for viewing the rasters with large volume or from slow media (CD, network).
- **Fill holes between cutlines** – if this option is **ON** then empty areas ("holes") between ROIs created during cutlines drawing are hatched by red color. (See also the chapter 7.2.3 Creating and editing Regions of Interest)
- **Trim off images edges** – allows to set percent of the image area to be cut from each side of initial image to eliminate fiducial mark's areas from resulting mosaic.

Windows:

- **Preview raster size** – allows to select maximum raster size (by lines or columns) in Preview window (the default value is 600). Increasing the parameter value causes improving raster quality but slows down the Preview building.
- **Block scheme** – allows to select number of strips and images included to the block scheme (see the chapter 6.7 Block scheme). For example if this parameter is 3 x 4 the block scheme consists of 3 strips by 4 images. The **Overlap** parameter is used to set up number of overlapping images in adjacent portions of the block scheme.
- **Display output mosaic** – opens window with resulting mosaic after its building
- **Open all sheets** – if this option is OFF and you are building the mosaic split into sheets, the only one of sheets is opened, and other ones you can view using the icons of upper button bar (,). If the option is ON you will get all sheets opened in separate windows.

- **Show images names** – turns off/on images names in images windows and also in preview and resulting mosaic.
- **Synchronous marker movement** – while working with block scheme window, the marker moves synchronously on adjacent images, which overlap with the current one. The option is ON by default. Use **X** key to turn on the option in image window.
- **Autocentering by synchronous marker movement** – if synchronous marker movement is **ON** (see previous option), the adjacent image is moved when marker moves on the first image to center the window into marker position.

The **Precision** tab of **Preferences** window is used to setup the parameter **Cell size decimal places**, which allows to input decimal places amount used for mosaic pixel size calculating.

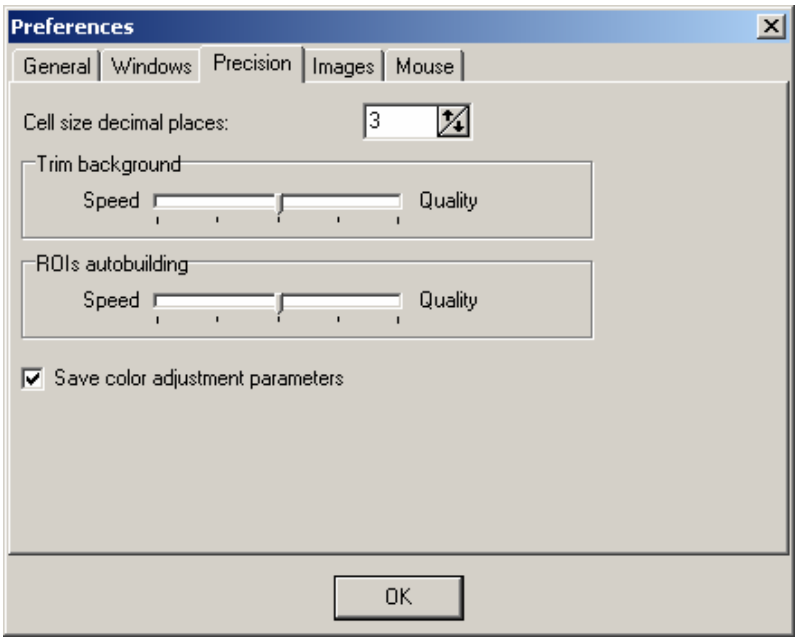


Fig.32 Mosaic precision settings

Two sliders located on this tab (**Trim background** and **ROIs autobuilding**) allow to adjust speed and quality of two processes: removing of background when building mosaic, and automatic cutlines creation.

The option **Save color adjustment parameters** is used when the project contains a big number of images. In this case brightness adjustment parameters, selected on the corresponding tabbed page (see the chapter 8.2 Brightness adjustment), are stored in file of the mosaic project. It allows to open a preview image more quickly when open the project for the next time.

The **Images** tab in **Preferences** window allows to create multiscale (pyramidal) images to speed up loading the images into mosaic project.

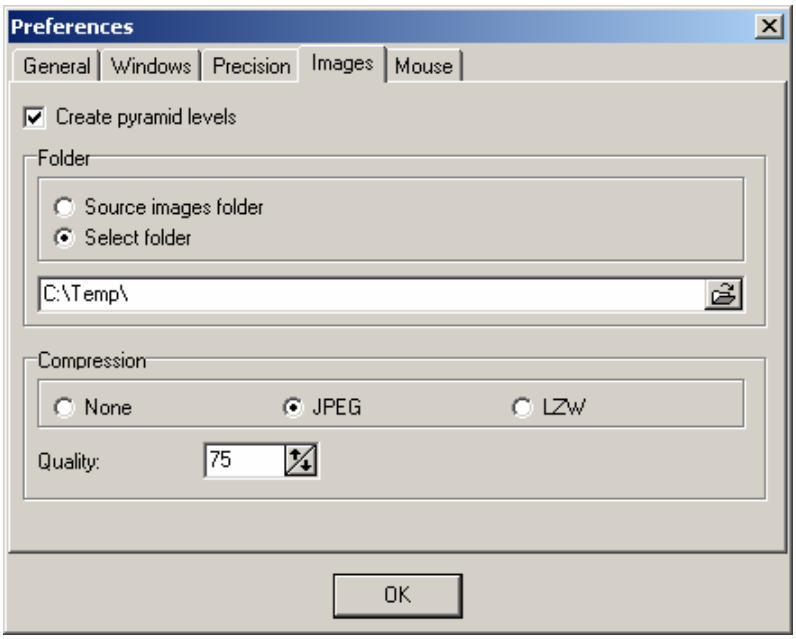


Fig.33 Preferences of multiscale images creation

If you create the mosaic using images of big enough volume, you are recommended to check the option of multiscale images creation (**Create pyramid levels**) to speed up their loading into mosaic project. After that specify target folder and path to save multiscale images (with PYR extension), and select compression mode and quality.

Use the command **Service | Delete multiscale images** to delete multiscale images from the project.

The **Mouse** tab is used to assign operations for mouse buttons (such as duplicating of **Insert**, **Enter**, **S** and other keys). These settings allow to simplify cutlines creation.

9. Mosaic preview

Once all necessary parameters are set, select menu command **Mosaic | Preview** or push the icon to see a mosaic preview. In this case mosaic is built in fast mode with low accuracy. It is convenient to use a preview mode for example to estimate the results of mosaic color adjustment.

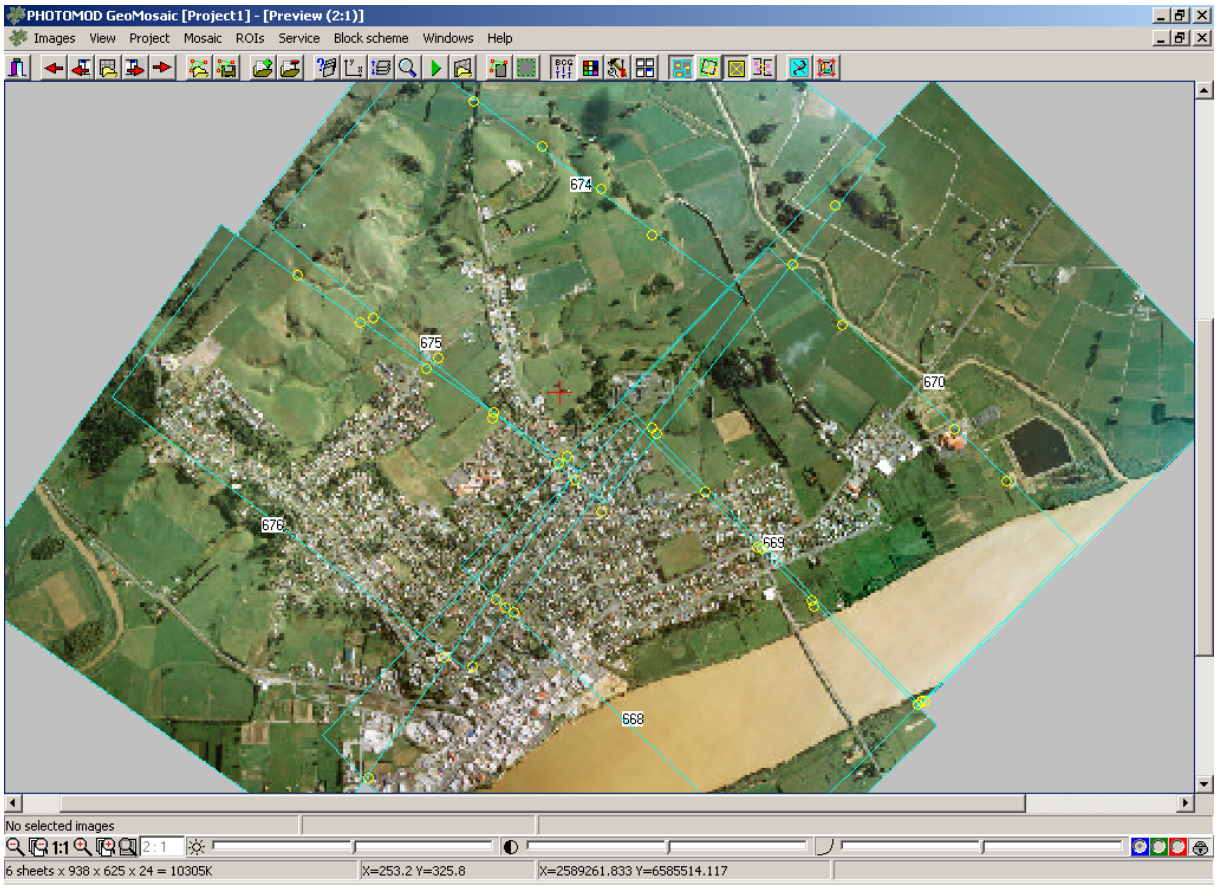


Fig.34 Mosaic preview window

At the lower left part of Preview window there are standard icons for displaying raster image:

- - one step zooming out (duplicated by "**/**" key)
- - one step zooming out (duplicated by "**/**" key) for all images opened
- - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by **Alt-1** shortcut)
- - one step zooming in (duplicated by "*****" key)
- - one step zooming in (duplicated by "*****" key) for all images opened
- - fitting the whole image into the window (duplicated by **Alt-Enter** shortcut)
- - fitting the whole image into the window for all images opened in block scheme (duplicated by **Alt-Shift-Enter** shortcut)

You can also use following key combinations to zoom arbitrary image fragment or move it:

- **Ctrl + Alt + mouse** zooming in by zoom box, "drawn" by mouse
- **Ctrl + Alt + Shift + mouse** zooming out by zoom box
- **Alt + mouse** panning the image
- **Mouse wheel** mouse wheel steering allows to zoom in/zoom out image on the screen

Following sliders (, ,), located at the bottom of the window, are used to set up brightness, contrast and gamma respectively for the active image.

When working with color images there is a possibility to adjust these radiometric parameters separately by channels (using the buttons). Right click any slider and select the option **Set original BCG correction** to restore BCG settings by default.

Note. Current coordinates of marker on the preview image (in project coordinate system) are shown in the rightmost field of Status panel. You can copy them to clipboard (by Ctrl-C) and paste afterward into chosen application (by Ctrl-V)

If you need to setup brightness of one image included to the mosaic select it by click inside the corresponding ROI (ROIs are displayed by pushing the icon or using **Alt-Z** hot keys). In this case all BCG settings will affect only the selected image.

Note. These settings are memorized and used for output mosaic creation

In the preview window the following main menu icons are used:

- - opens/hides a window for specifying the **Images order** for including fragments of sources images into output mosaic in the overlapping area, see the chapter 8.2.4 Additional recommendations
- (duplicated by **Alt-Z** hot keys) - shows/hides regions of interest in preview and output mosaic windows
- - shows/hides sheet borders if output mosaic is divided into map sheets (the appropriate option is **ON** in **Splitting into sheets** tab of **Parameters** window, see the chapter 10 Splitting mosaic into map sheets)

Select a rectangular area in the **Preview** window to include only a corresponding portion of the source block of images into output mosaic. Use mouse move along with pressed **Shift** key to draw a rectangle on the image. The polygon can be resized by dragging special marks on its sides or moved by dragging. See also the chapter 11.2 Building mosaic for the block fragment.

10. Splitting mosaic into map sheets

Output mosaic could be divided into map sheets. Use the tab **Mosaic | Parameters | Split into sheets** (Fig.35) to specify splitting parameters.

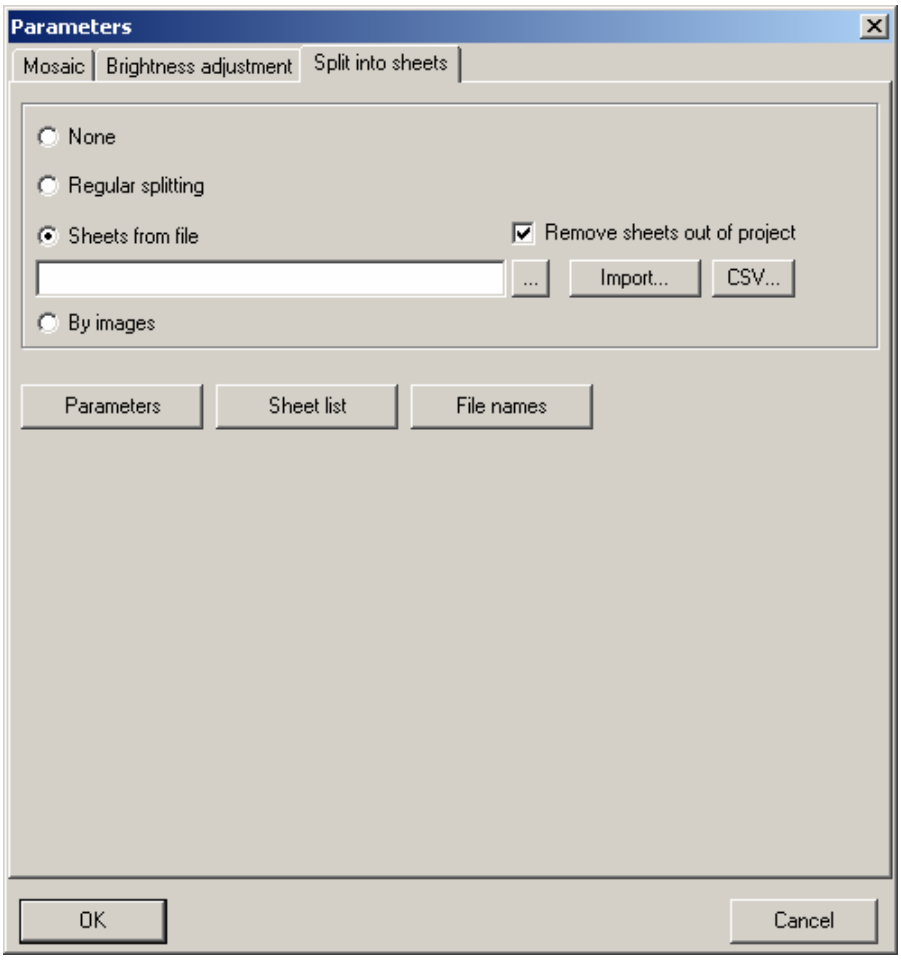


Fig.35

Use the following ways to split output mosaic into sheets:

- **Regular splitting** – select the option **Regular splitting** and specify splitting parameters, see the chapter 10.1 Splitting parameters. At that the whole mosaic is divided into sequential map sheets according to the parameters selected.
- **Sheets from files** – select the option **Sheets from files** and load sheet borders exported from **PHOTOMOD** system resources in txt format (in the window opened by the button ...) or import them from external formats txt, lst, dxf, csv or MIF/MID (in the window opened by the **Import** button), see the chapter 10.4 Loading sheet coordinates from the text file. Besides you can rename files with sheets and frames of mosaic into work numbers (in the window opened by the **CSV** button, see the chapter 11.6 Creating marginalia for mosaic).
- **By images** – borders of images are used as borders of mosaic sheets, if the option **By images** is selected. At that each initial image of mosaic project is considered as map sheet. Sheet names are defined as initial images names in GeoMosaic project (and they could be changed if necessary). Sheets management (turn ON/OFF, rename) is the same as for **Regular** sheets splitting, see the chapter 10.1 Splitting parameters.

If the check box **Remove sheets out of project** is marked (by default) the map sheets on the image area which is out of project territory will be not created. If it is necessary to import and show all sheets irrespective of their location on mosaic project, clear the check box and re-build the preview to see where the sheets are located.

You can also exclude sheets manually on preview image as described in the chapter 10.2 Splitting preview.

10.1. *Splitting parameters*

If you split the mosaic into **Regular sheets** or **By images**, specify the parameters of splitting in the window opened by the button **Parameters** from the tab **Mosaic | Parameters | Splitting into sheets**.

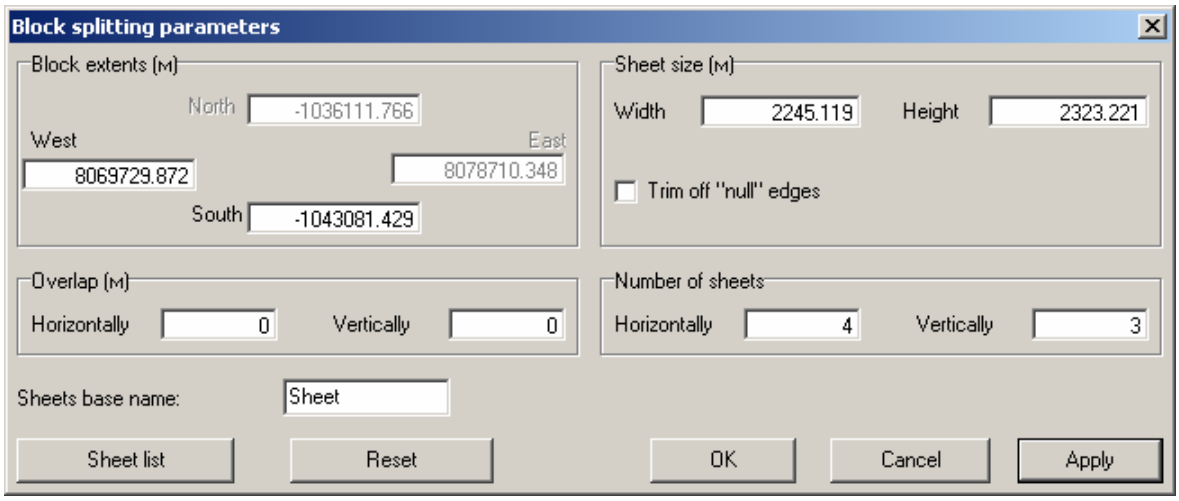


Fig.36

To change the extents of the mosaic enter new coordinate values of mosaic corners in **West**, **South** text fields. Sheet sizes are defined in **Width** and **Height** text fields in meters on the terrain. As a result number of sheets by X and Y axes are displayed in **Number of sheets / Horizontally** and **Number of sheets / Vertically** text fields. You can also set overlapping areas of adjacent sheets in meters (**Overlap (m) / Horizontally** and **Overlap (m) / Vertically**).

If the **Trim off "null" edges** option is on the size of uppermost and rightmost sheets are changed to cut them off by the mosaic border. In this case number of sheets is calculated automatically and can not be edited. If this option is off all sheets are of the same size (defined by **Width** and **Height** parameters) and the **North** and **East** coordinates are calculated automatically and can not be edited.

In **Sheets base name** field you should input "root" name of mosaic sheets (**Sheet** by default). At that full file name of the sheet is formed as follows: <Base name (5 characters)>_<literal number of the sheet along the South-North direction (A, B, …, Z)>_<numerical number of the sheet along the West-East direction (1,2,3,…) >.<file extension according to the selected file type>.
See also the chapter 10.3 Sheet file names.

Push the button **Sheet list** to open a window with full information corresponding to current state of the block sheets: total number of sheets, number of selected sheets to be included into mosaic and the information about each separate sheet: file name, border and status (create mosaic / not create mosaic), see Fig.37.

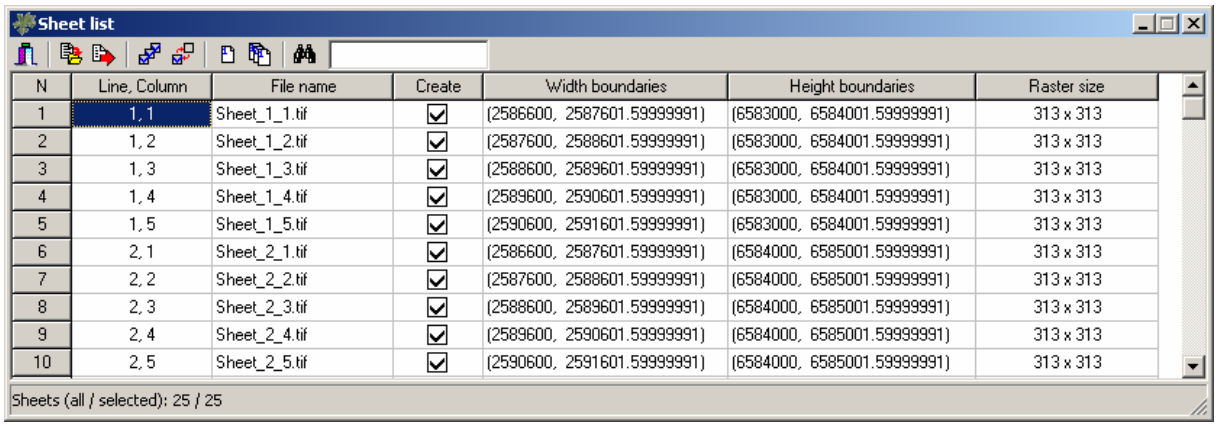


Fig.37

In this window you can change the sheet status (create/skip) by checking/clearing the check box in the **Create** column.

For editing of file name of selected sheet push the button (**change sheet name**) and input new name in the window appeared. For editing of selected sheet name you can use the following keys: **F2** – to start editing, **Enter** – to save new name, **Esc** – to cancel changing.

If you need to change all sheets names push the button (**rename created sheets**), which opens a window intended for renaming of all mosaic sheets in the following way.

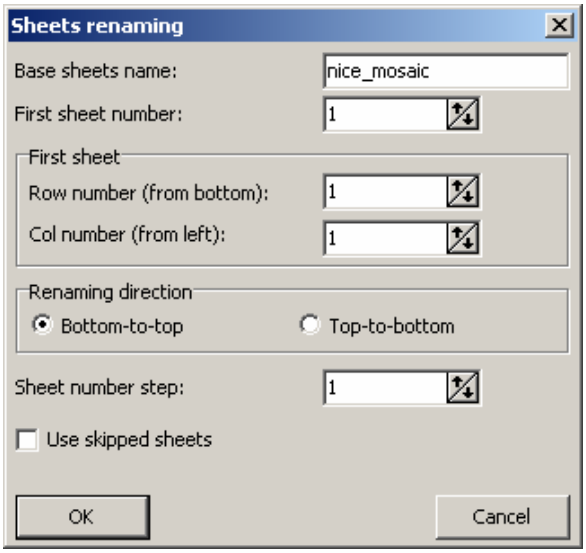


Fig.38 Mosaic sheets renaming

Input new sheet name in the **Base sheets name** field and its starting number in **First sheet number** field. In the **First sheet** panel select the position of a sheet which number is start of numeration for the whole sheets block. For that indicate a number of row (starting from the bottom of mosaic scheme) and column (from leftmost one on scheme) in appropriate fields.

You may indicate the direction of renaming **(bottom-to-top** or **top-to-bottom** on scheme), and also input a step value for sheets numeration increasing (in the **Sheet number step** field).

For renaming of sheets that are skipped during mosaic creation, mark the **Use skipped sheets** check box (they have no numeration by default).

You can select all sheets in the list using the icon **Select all**, and invert previous selection by the icon **Invert selection**.

To search a sheet by its name or name fragment in the **File name** column of sheets list, input symbols into search field and push the button **Find sheet** or press **Enter**.

Click the icon **Save** to save sheets borders to file in TXT format, after that input file name and path in the window opened.

Mosaic sheets parameters created in this window could be exported to TXT, DXF or CSV format. Push the button **Export** and specify output file name and path in the window opened.

To exit **Sheet list** window click the icon or cancel parameters editing by clicking **Esc**.

Note. Block must contain at least one sheet. When the number of sheets is one its status is always "To be created" and it cannot be excluded from processing

Once splitting parameters are selected, push **OK** and open preview window with splitting results, see the chapter 10.2 Splitting preview.

10.2. *Splitting preview*

To display the results of splitting mosaic into sheets push the icon of the main icon bar or select menu command **Mosaic | Preview** to open Preview window (Fig.39).

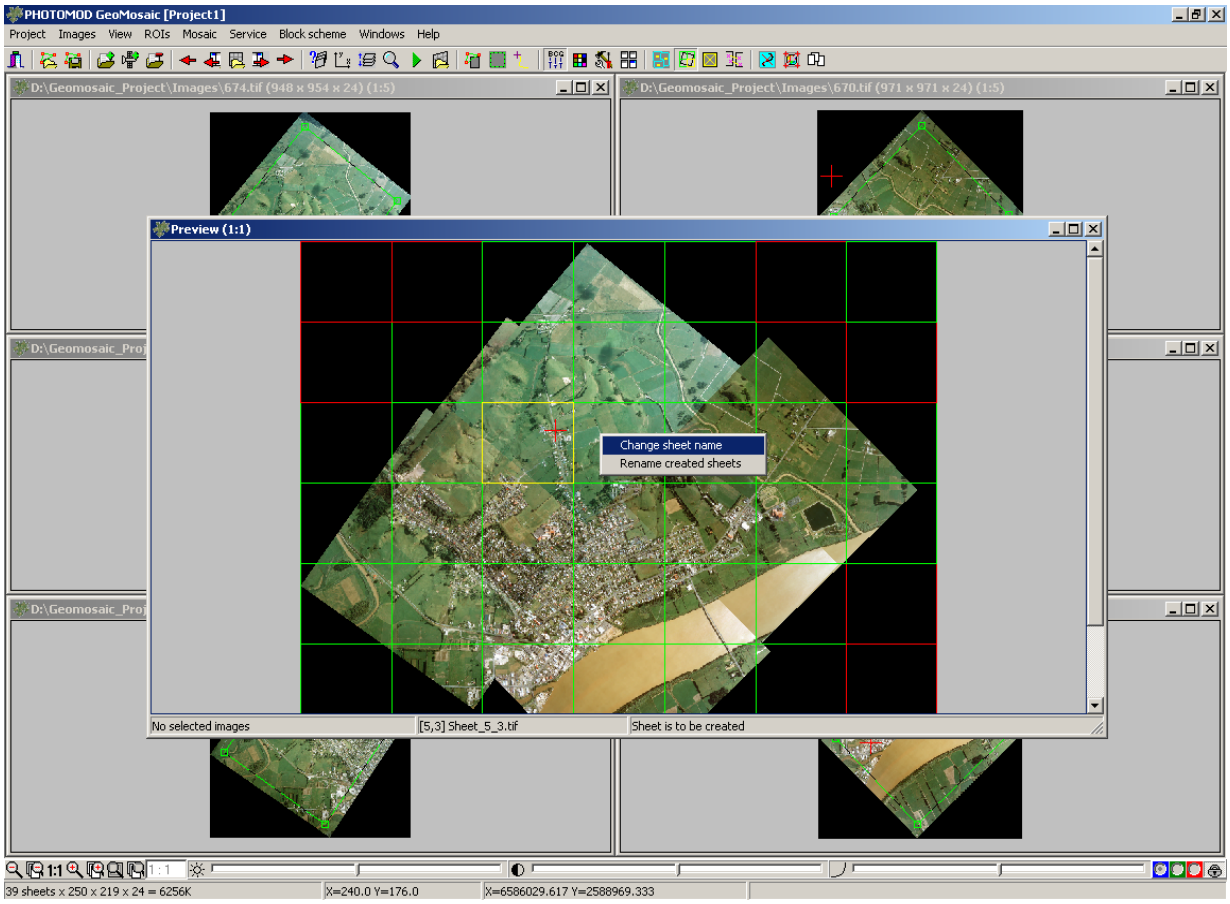

PHOTOMOD GeoMosaic [Project1]
Project Images View ROIs Mosaic Service Block scheme Windows Help
D:\Geomosaic_Project\Images\674.tif (948 x 954 x 24) (1:5)
D:\Geomosaic_Project\Images\670.tif (971 x 971 x 24) (1:5)
Preview (1:1)
Change sheet name
Rename created sheets
No selected images
[5,3] Sheet_5_3.tif
Sheet is to be created
39 sheets x 250 x 219 x 24 = 6256K
X=240.0 Y=176.0
X=6586029.617 Y=2588969.333

Fig.39 Preview of splitting into map sheets

When the button (**Sheet extents**) is pushed, click the selected sheet in preview image and it will be bounded by yellow frame and its file name will be displayed under preview window. Its **Status** parameter can be one of two choices – **to be created / to be skipped**. The lower string of the window (**Status**) shows the number of map sheets and a volume of resulting mosaic in kilobytes.

Frame of a sheet to be created is green and of a sheet to be skipped – red.
To include / exclude selected mosaic sheet from processing (change its status) use mouse double click in preview window.

You can select and include/exclude a group of map sheets to/from output mosaic on preview image by the following ways:

- When using **regular** or **by images** splitting on map sheets (see the chapter 10 Splitting mosaic into map sheets) you can include/exclude sheet's group by frame using mouse along with **Shift** key pressed. For that click sheet in a corner of group (its border becomes yellow), then click opposite corner of a group along with **Shift** key pressed. If the first sheet selected was excluded from output mosaic, the whole group of sheets will be excluded either.

- When using custom sheets (created using the option **Sheets from files**, see the chapter 10 Splitting mosaic into map sheets) you can exclude sheets by frame using mouse along with **Ctrl-Shift** pressed.

- To include custom sheets by frame use mouse along with pressed **Ctrl** key.

Sheets renaming is available from contextual menu (opened by right click of sheet on preview image) (Fig.39). Select command **Change sheet name** to rename only selected sheet. **Rename created sheets** command is intended for renaming of all names of mosaic sheets using opened window, described in the chapter 10.1 Splitting parameters.

Note. Block must contain at least one sheet. When the number of sheets is one its status is always "To be created" and it cannot be excluded from processing

You can create frames and marginalia for mosaic sheets in styles and symbols used in Russian State Land Use Survey in 1:2,000, 1:5,000, 1:10,000 and 1:25,000 map scales for MicroStation and MapInfo systems, see the chapter 11.6 Creating marginalia for mosaic.

10.3. *Sheet file names*

Push the **File names** button in the **Mosaic** window (opened by the command **Mosaic | Parameters | Split into sheets**) to open **Sheets file** window:

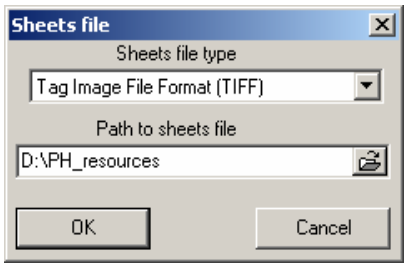


Fig.40

In this window you can edit the file type (its format) and the path to sheet files, where the sheets are stored after mosaic creation. Files of map sheets have the same format, as the mosaic, which is not divided into sheets, see the chapter 11.1 Building and viewing mosaic.

10.4. *Loading sheet coordinates from the text file*

To load coordinates of sheet borders from a text file select the option **Sheets extents from files** at the **Split into sheets** panel. While working in this mode you can not change splitting parameters (the **Parameters** button is inactive), since full splitting information is stored in the text file. You can also import sheets coordinates by clicking the **Import** button on **Split into sheets** tab. It allows to import file with map sheets borders to the following formats: .txt, .lst, .dxf, .csv or MIF/MID.

At that you can change coordinate system from left- to right-handed or vice versa, by checking the option **Swap X, Y**.
When importing sheets from MIF/MID format you can import sheets' names from attribute. Input attribute name (**ID** or **Orto**) containing names of map sheets to be imported in the **Attribute with sheet names** field in window of import parameters.

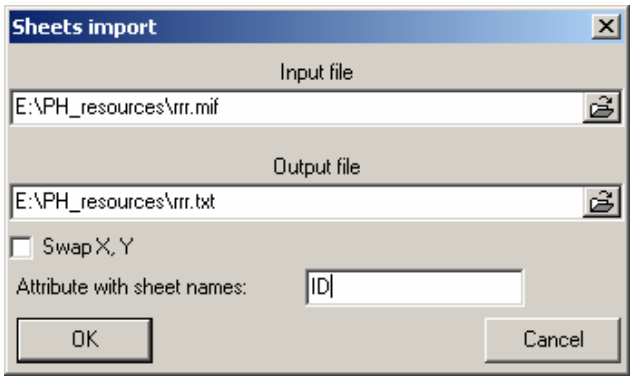


Fig.41 Import sheets from file

A sample of the file with sheet borders (coordinates of corners) in text format:

[MainSection]
SheetCount=5

[Sheet0]
Name="Sheet_1.tif"
X0=535017.208
Y0=164805.265
X1=535517.248
Y1=164805.265
X2=535517.248
Y2=165305.305
X3=535017.208
Y3=165305.305

[Sheet1]
Name="Sheet_2.tif"
X0=535517.208
Y0=164805.265
X1=536017.248
Y1=164805.265
X2=536017.248
Y2=165305.305
X3=535517.208
Y3=165305.305

[Sheet2]
Name="Sheet_3.tif"
X0=536017.208
Y0=164805.265
X1=536517.248
Y1=164805.265
X2=536517.248
Y2=165305.305
X3=536017.208
Y3=165305.305

[Sheet3]
Name="Sheet_4.tif"
X0=536517.208
Y0=164805.265
X1=537017.248

```
Y1=164805.265
X2=537017.248
Y2=165305.305
X3=536517.208
Y3=165305.305

[Sheet4]
Name="Sheet_5.tif"
X0=535017.208
Y0=165305.265
X1=535517.248
Y1=165305.265
X2=535517.248
Y2=165805.305
X3=535017.208
Y3=165805.305
```

Note. If borders are loaded from text file, the sheets can be of any convex quadrangle shape (for example – a trapeze)

11. Building mosaic

11.1. *Building and viewing mosaic*

Mosaic creation is started by menu command **Mosaic | Build!** or by clicking the icon of the main icon bar, that opens standard OS Windows dialog of output file name selection (**Save as** window). In case of splitting the mosaic into sheets (if the appropriate option is ON, see the chapter 10 Splitting mosaic into map sheets), the dialogue of file name input appears, where you should input file name of output map sheets (see the chapter 10.3 Sheet file names).

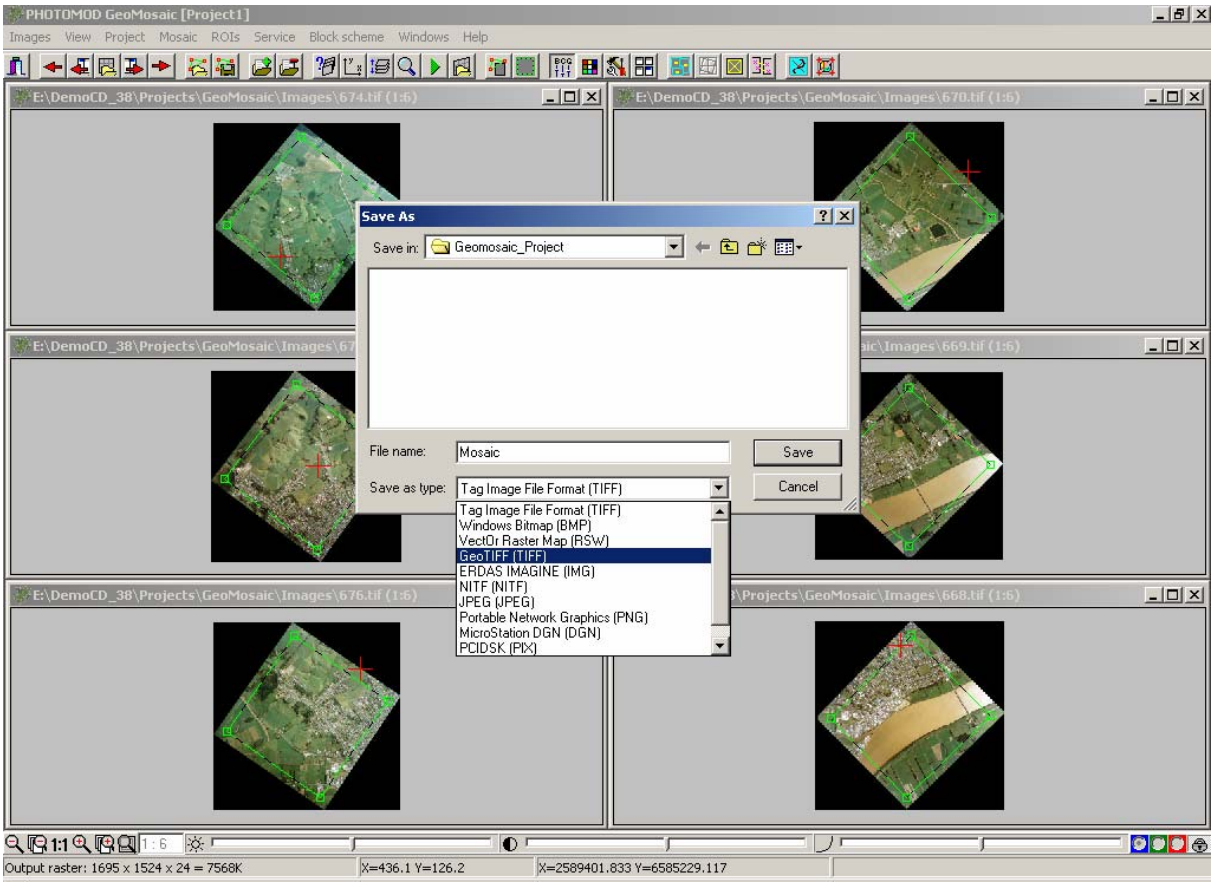


Fig.42 Selecting output mosaic format

Mosaic image is created in the following output formats selected from drop-down list:

- **Tag Image File Format (TIFF)** – allows to save output mosaic with or without JPEG compression (depending on the option in **Mosaic | Parameters | Mosaic** window, see the chapter 8.1 Mosaic)
- **Windows Bitmap File (BMP)**
- **VectOr** format (see the chapter 12 Export mosaic to PHOTOMOD VectOr)
- **GeoTIFF** – TIFF format, containing special tags with georeference. This option is not available for local and Cartesian coordinate systems
- **ERDAS IMAGINE (IMG)** – raster format of ERDAS system
- **NITF (NITF)**
- **JPEG (JPEG)**
- **PNG (PNG)**
- **DGN (DGN)** – raster format of MicroStation system, allows to save adaptive color palette for output mosaic
- **PCIDSK (PIX)** – raster format with georeference data in its header, developed by PCI Geomatics
- **JPEG2000 (JP2)** – raster format with jpeg-compressing and georeference data in its header, output image in this format has limited volume up to 500 Mb.

After path and file name input push the **Save** button to start mosaic creation. At that georeference file is saved along with mosaic file in the same folder, see the chapter 15 Georeference file.

When the building is complete a window with output mosaic opens, if the option **Display output mosaic** is ON (see the chapter 8.4 Preferences).

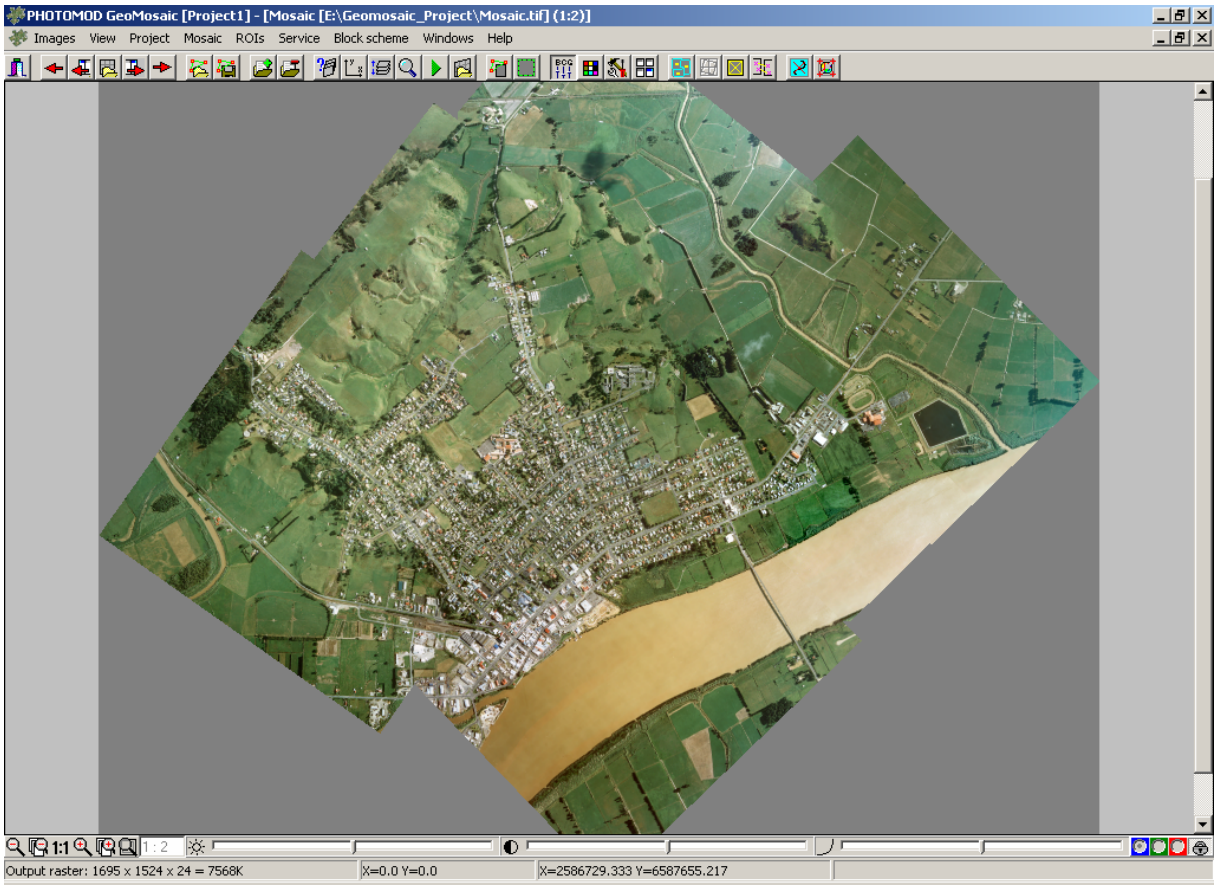

PHOTOMOD GeoMosaic [Project1] - [Mosaic [E:\Geomosaic_Project\Mosaic.tif] (1:2)]
Images View Project Mosaic ROIs Service Block scheme Windows Help
1:1
1 : 2
Output raster: 1695 x 1524 x 24 = 7568K
X=0.0 Y=0.0
X=2586729.333 Y=6587655.217

Fig.43 Mosaic window

At the lower left part of Mosaic window there are standard icons for raster image managing:

- - one step zooming out (duplicated by "**/**" key)
- - one step zooming out (duplicated by "**/**" key) for all images opened
- - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by **Alt-1** keys)
- - one step zooming in (duplicated by "*****" key)
- - one step zooming in (duplicated by "*****" key) for all images opened
- - fitting the whole image into the window (duplicated by **Alt-Enter** keys)
- - fitting the whole image into the window for all images opened in block scheme (duplicated by **Alt-Shift-Enter** keys)

You can also use following key combinations to zoom arbitrary image fragment or move it:

- **Ctrl + Alt + mouse** zooming in by zoom box, "drawn" by mouse
- **Ctrl + Alt + Shift + mouse** zooming out by zoom box
- **Alt + mouse** panning the image
- **Mouse wheel** mouse wheel steering allows to zoom in/zoom out image on the screen

Following sliders (, ,), located at the bottom of the window, are used to set up brightness, contrast and gamma respectively for the active image.

When working with color images there is a possibility to adjust these radiometric parameters separately by channels (using the buttons). Right click any slider and select the option **Set original BCG correction** to restore BCG settings by default.

Note. These settings are temporary and do not affect the mosaic file

Show the regions of interest on the output mosaic by pushing the icon (or **Alt-Z** hot keys), that allows also using export/import operations for ROI's.

Note. Current coordinates of marker on the preview image (in project coordinate system) are shown in the rightmost field of Status panel. You can copy them to clipboard (by Ctrl-C) and paste afterward into chosen application (by Ctrl-V)

11.2. *Building mosaic for the block fragment*

You can select a rectangular area in the Preview window (see the chapter 9 Mosaic preview) to create mosaic only for corresponding portion of the source block of images. Use **Shift + left mouse button** to draw a rectangle on the image. You can resize the polygon by dragging special marks on its sides or move it by the mouse. To input coordinates of the fragment corners from the keyboard use the **Coordinates** window, opened by menu command **Mosaic | Coordinates** or by the icon . Once the fragment is specified, start mosaicking in a standard way (by clicking the icon or menu command **Mosaic | Build!**). This mode is useful for quick visual results control on small mosaic portions.

11.3. *Mosaic editing in Dust Correct application*

After mosaic building you can "clean" the artifacts there – images of dust particles, photo emulsion defects etc. For this purpose you can use special application **Dust Correct**, which opens by pushing the icon in main menu of **PHOTOMOD GeoMosaic** module.

Note. Dust Correct application works with the images in Windows BMP and Stripped SingleScale TIFF formats without compression. If you try to open the image of any other format, it is opened in "read only" mode

Open the image selected from the list appeared after clicking main menu command **File | Open image** or the hot keys **Ctrl-O** or pushing the icon .

For the convenient searching for the artifact, zoom in the initial image (by hot key "*****", for instance) and find the defect while panning the image by hot keys **Alt-mouse** or by the keyboard (**Shift-keyboard arrows**). Then select the fragment containing not only artifact, but also an image part with similar texture for substitute (cleaning) the image.

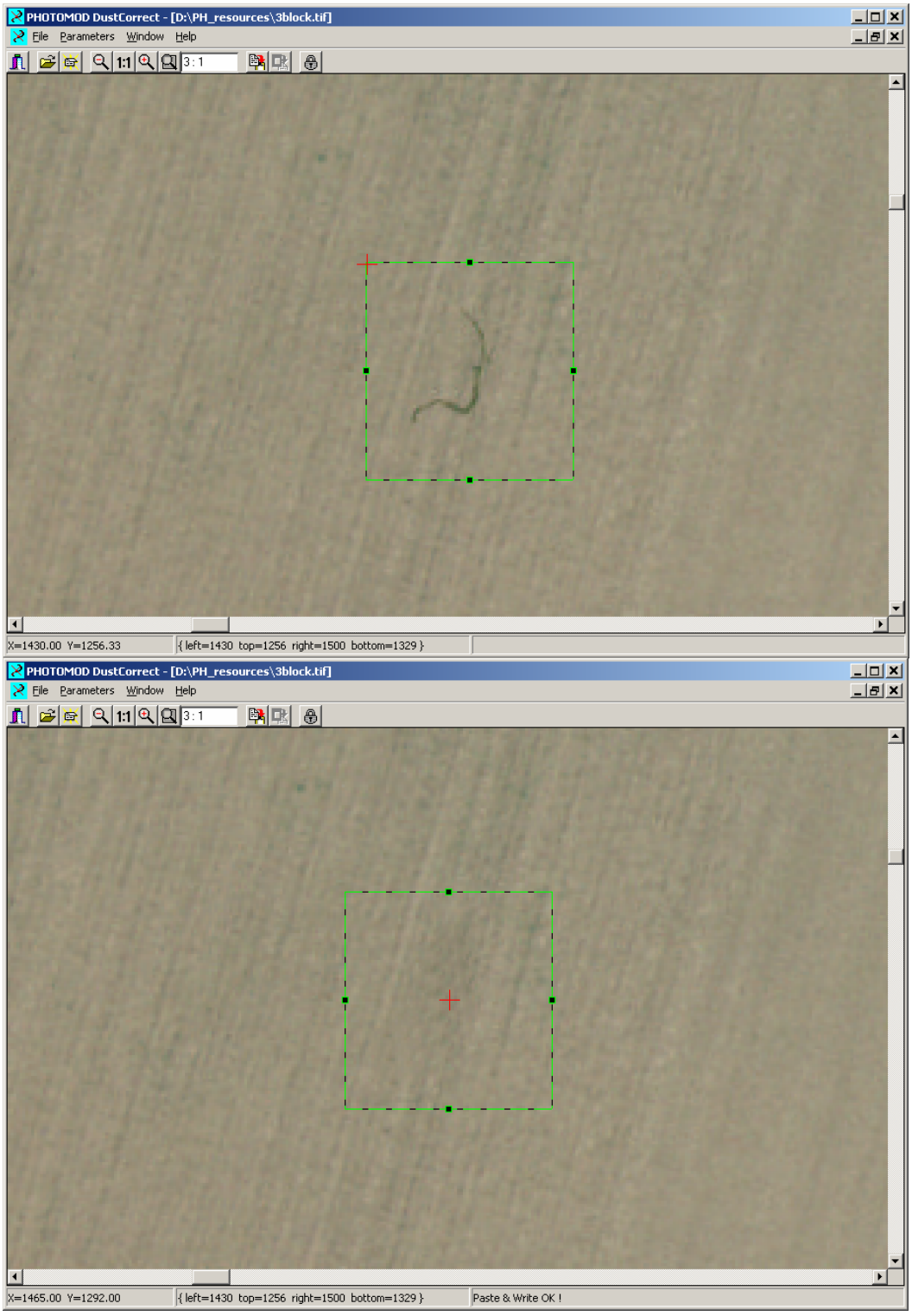


Fig.44 Image processing result in Dust Correct application window

For selecting the fragment by green frame use **Shift-mouse** combination, to cancel selection click **Esc**.

You may open and edit the fragment selected either in **PHOTOMOD** built-in editor or in external software. To open selected image in built-in editor open the Parameters panel using menu command **Parameters | Parameters** and check out the option **Use internal editor** (Fig.45).

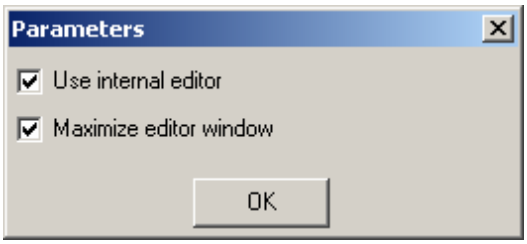


Fig.45

Then copy the fragment to the clipboard (using standard OS Windows command – **Ctrl-C** or pushing the icon **Copy to clipboard** of **Dust Correct** toolbar). After that, the **Editor** window containing the fragment selected opens.

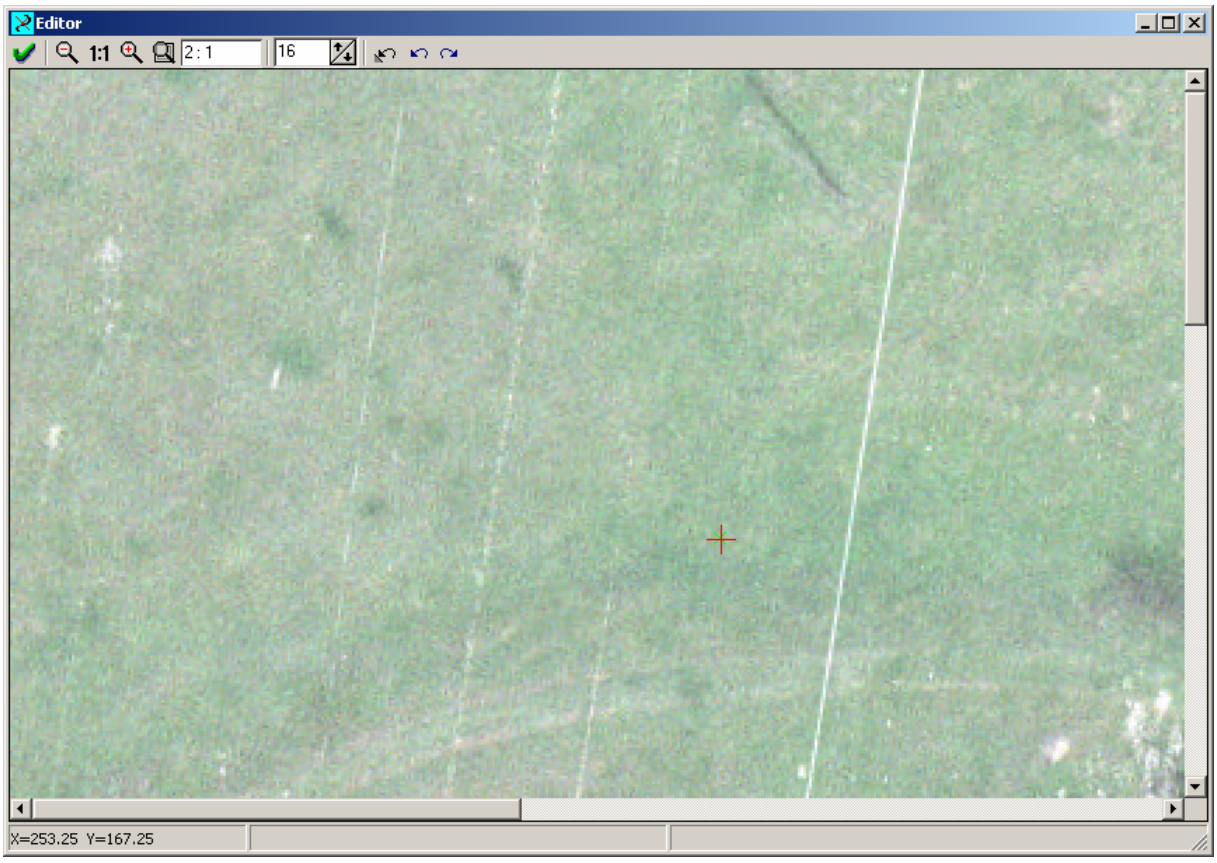
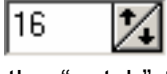


Fig.46 Editor window

In the **Editor** window place the mouse cursor in the “source point” (by **Shift-mouse click**) – the exact place where the image texture fits closely the needed one. At that you can set the aperture value (in the upper numeric field 

) – the diameter of the circle around the “source point”, which is the source of the “patch” texture. Afterwards clean the artifact using mouse moves. Use the following buttons to perform undo/redo operations:

- undo all – to cancel all actions in the Editor window

(or **Ctrl-Z** shortcut) - cancel – to cancel the last action in the Editor window

(or **Shift-Ctrl-Z** shortcut) - redo – to redo cancelled action.

When obtained satisfying result push the icon that closes the **Editor** window and pastes edited fragment to **Dust Correct** window. To cancel editing results and exit without image change, just close the **Editor** window.

If you prefer to edit the image in the external graphic software, copy the image or its fragment there by standard OS Windows operations copy/paste (**Ctrl-C**/**Ctrl-V**) or use the icons **Copy to clipboard** and **Paste from clipboard**. At that the option **Use internal editor** in **Parameters** panel (opened by menu command **Parameters | Parameters**, see Fig.31) should be cleared.

The icon (**Disable changes**) or **Ctrl-L** shortcut is used for fixation of the fragment frame size, intended for external editing (to fit its former place after editing).

Use the icon or hot keys **Ctrl-F4** to close the image without exit from **DustCorrect** module.

11.4. *Measurements over mosaic*

There is a possibility to make control measurements of distances on the mosaic. Just click left mouse button, drag a line to the point you need and release the button. You will get a distance value **L** displayed at the bottom of window.

11.5. *Loading mosaic*

You can load and view previously created orthomosaic (using menu command **Mosaic | Open** or the icon or hot keys **Ctrl-Alt-O**) from the following formats:

- **Tag Image File Format (TIFF)** – selected folder should contain tiff file with mosaic and also georeference file with the same name (see the chapter 15 Georeference file).
- **Windows Bitmap File (BMP)**
- **VectOr (SIT, RSW, MTW)** – raster format of **PHOTOMOD VectOr** system, see the chapter 12 Export of mosaic to PHOTOMOD VectOr
- **IMG** – raster format of ERDAS system
- **NITF**
- **JPEG**
- **GIF**
- **PNG**
- **USGS DEM (DEM)**.

11.6. *Creating marginalia for mosaic*

It is possible to create map frame and marginalia in styles and symbols used in Russian State Land Use Survey in 1:2,000, 1:5 000, 1:10 000 and 1:25 000 map scales for MicroStation and MapInfo systems, using the command **Mosaic | Create marginalia**.

12. Export of mosaic to PHOTOMOD VectOr

PHOTOMOD VectOr is a GIS and Desktop Cartography module of **PHOTOMOD** system, used basically for creating and printing out digital maps (see **VectOr** User Manual).
PHOTOMOD GeoMosaic supplies export of orthomosaic and corresponding DEM to **PHOTOMOD VectOr**.

To export mosaic to VectOr format, select menu command **Mosaic | Build!** and specify output file type as **VectOr (RSW)**.

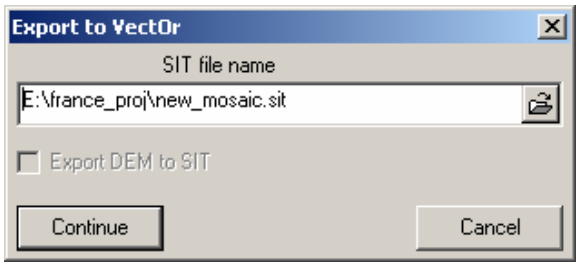


Fig.47 Map file selection dialog

In the window opened input the name and path of output mosaic in **SIT file name** field.

In case of new **VectOr** map creation you get a dialog with the following fields to be filled in:

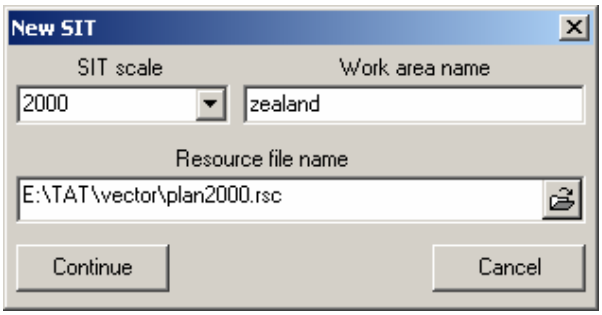


Fig.48

- **SIT scale** – select the scale of output mosaic (1:2,000 by default)
- **Work area name** – arbitrary name of output map region (up to 31 character)
- **Resource file name** – name of file with a map symbol library (.rsc file). Several standard "classifiers" for different map scales are included to **PHOTOMOD** system (stored in PHOTOMOD \ VectOr folder). See also **GIS VectOr** User Manual.

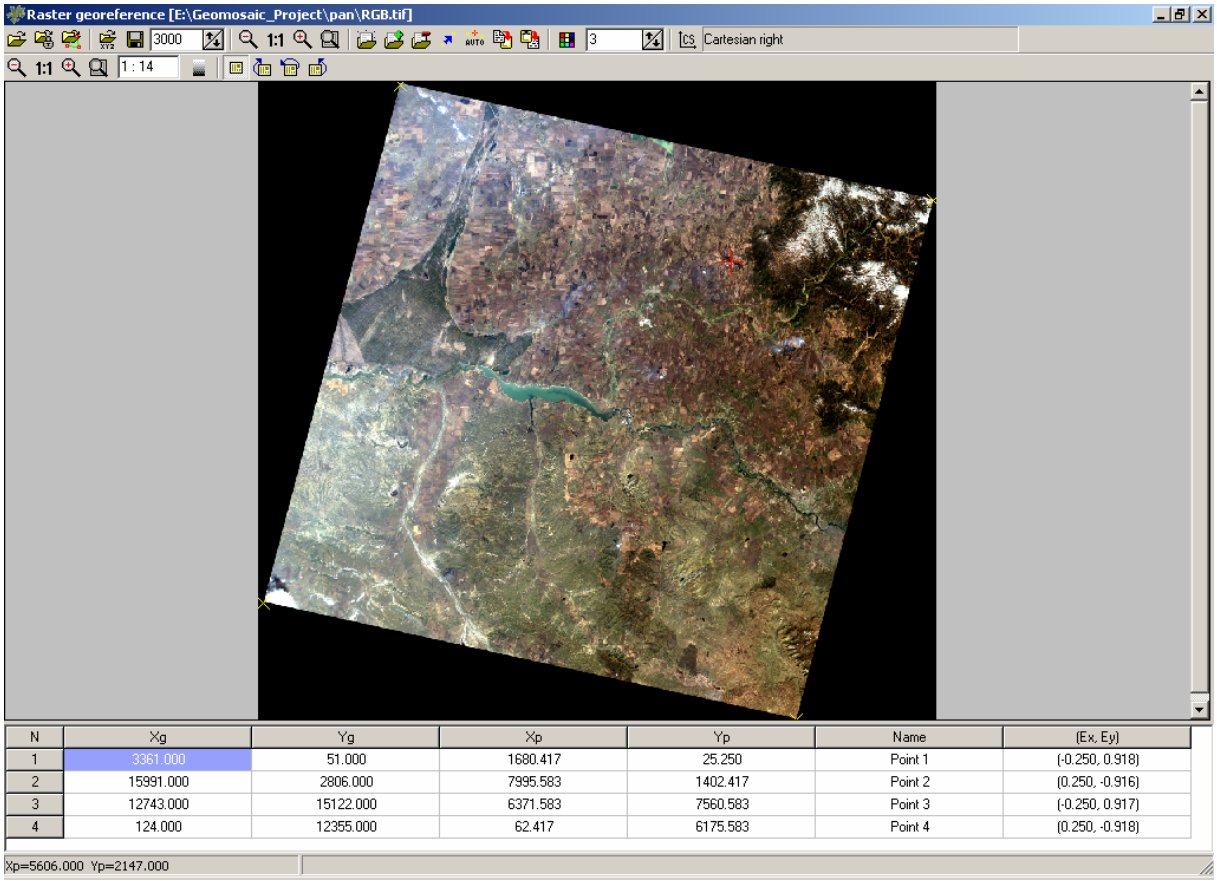
Note. Since VectOr always works with a left-handed coordinate system (X – to the north, Y – to the east) mosaic coordinates will be swapped accordingly

Click the button **Continue** to start creating mosaic in **GIS VectOr** format.

13. Pan sharpening operation

PHOTOMOD GeoMosaic module allows to perform pan sharpening operation which includes merging of color (or multispectral) image with panchromatic one with higher spatial resolution, that leads to creation of color image with high spatial resolution.

Initial images used for this operation should be georeferenced. If there is no reference to coordinate system, use raster georeference window, see the chapter 7.4 Raster image georeferencing.



N	Xg	Yg	Xp	Yp	Name	(Ex, Ey)
1	3361.000	51.000	1680.417	25.250	Point 1	(-0.250, 0.918)
2	15991.000	2806.000	7995.583	1402.417	Point 2	(0.250, -0.916)
3	12743.000	15122.000	6371.583	7560.583	Point 3	(-0.250, 0.917)
4	124.000	12355.000	62.417	6175.583	Point 4	(0.250, -0.918)

Xp=5606.000 Yp=2147.000

Fig.49 Georeferencing of initial color image

Than push the button on toolbar (or select menu command **Service | Pan sharpening**), and in dialogue opened select file with images to perform pan sharpening:

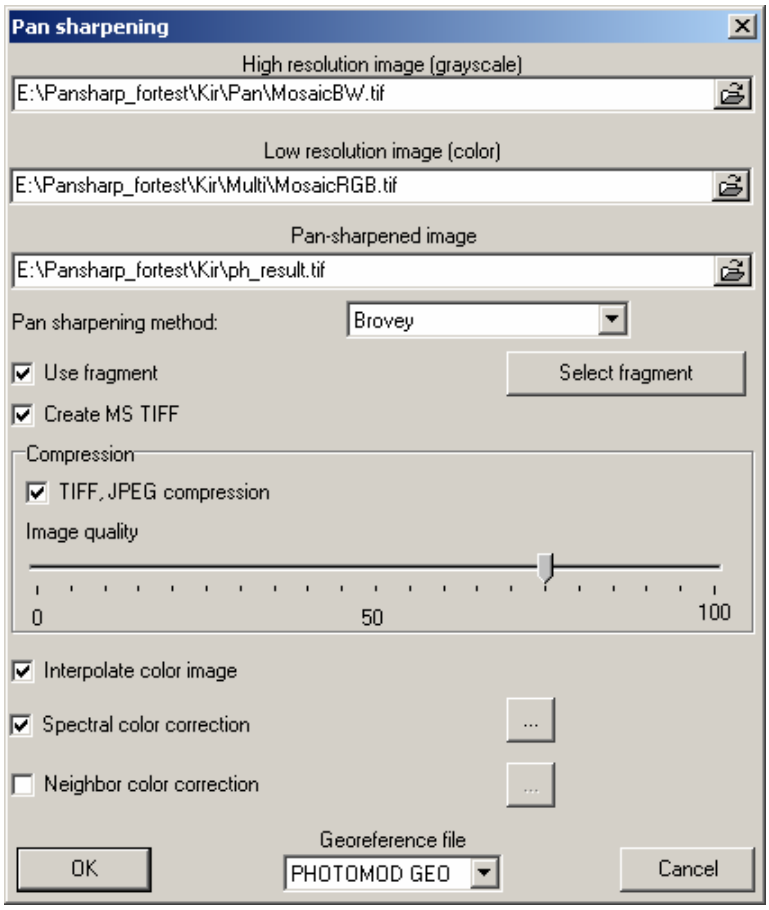


Fig.50 Pan sharpening parameters

Input path to initial images in two upper fields of the window – **High resolution image (grayscale)** and **Low resolution image (color)**.

To select file name and format of output image click the button in **Pan-sharpened image** field and input image file name and select its format in drop-down list in the window opened.

PHOTOMOD GeoMosaic system allows to create pan-sharpened images in the following output formats selected from drop-down list:

- **Tag Image File Format (TIFF)** – allows to save output file with or without JPEG compression (depending on the option in the **Compression** panel, see below)
- **Windows Bitmap File (BMP)**
- **GIS Panorama raster map (RSW)** – raster format of Panorama system (see the chapter 12 Export mosaic to PHOTOMOD VectOr)
- **GeoTIFF** – TIFF format, containing special tags with georeference
- **ERDAS IMAGINE (IMG)** – raster format of ERDAS system
- **NITF (NITF)**
- **JPEG (JPEG)**
- **PNG (PNG)**
- **DGN (DGN)** – raster format of MicroStation system
- **PCIDSK (PIX)** – raster format with georeference data in its header, developed by PCI Geomatics
- **JPEG2000 (JP2)** – raster format with jpeg-compressing and georeference data in its header, output image in this format has limited volume up to 500 Mb.

Pan sharpening operation is performed using one of three methods: **HSV**, **Brovey** and **Principal components**. If you need to obtain different result select another method, using **Pan sharpening method** drop-down list.

Usually it is not easy to predict in advance how the results of each method will differ. One or another way would be preferable depending on input images type. **HSV** and **Principal components** methods allow to obtain similar results on images, where there is no evident dominance or lack of some color. **Brovey** algorithm is close to them on images with average brightness, but differs on darkened or too bright images. It is also hard enough to define preliminary what color balancing parameters to choose.

Note: it is recommended first to perform pan sharpening operation for image fragment to adjust the method and color balancing parameters, and then apply them to the whole image and to other similar images

You can process some part of an image when the option **Use fragment** is marked. Push the button **Select fragment** and select the fragment in the opened window. For that drag green frame by mouse along with pressed **Shift** key. You can move the frame over the image by mouse along with pressed **Ctrl** key. To resize the frame drag small squares on its sides by the mouse. Press **Esc** to cancel fragment selection. If you are satisfied with the fragment selected (push **OK**) or press **Enter** to save selection and close window. Push **Cancel** to close the window without changes.

For speeding up the scaling of output image mark **Create MS TIFF** check box, that will allow to create pyramid levels in output image of TIFF or GeoTIFF format.

Check the option **TIFF, JPEG compression** in the **Compression** panel to reduce the output image (JPEG compression will be applied to TIFF files) and then select the level of compression using **Image quality** slider. The value of compression is 75% by default (as a rule, it allows to compress the image 5-7 times more).

The color of output image is adjusted using the options **Interpolate color image**, **Correct colors use spectrum**, **Correct colors use area**, described in the chapter 13.1 Color balancing of output image.

When all parameters are set up push the **OK** button to start the process of pan-sharpened image creation. At that the accompanying georeference file will be saved to the same folder in format selected in the **Georeference file** drop-down list (see the chapter 15 Georeference file).

After completing the process the output image window is opened.

13.1. *Color balancing of output image*

Prior to color balancing parameters adjustment you should keep in mind that the closer the colors of output image to colors of the initial raster, the more loss of output image details.

The following options of Pan sharpening parameters window are used for color balancing of output image.

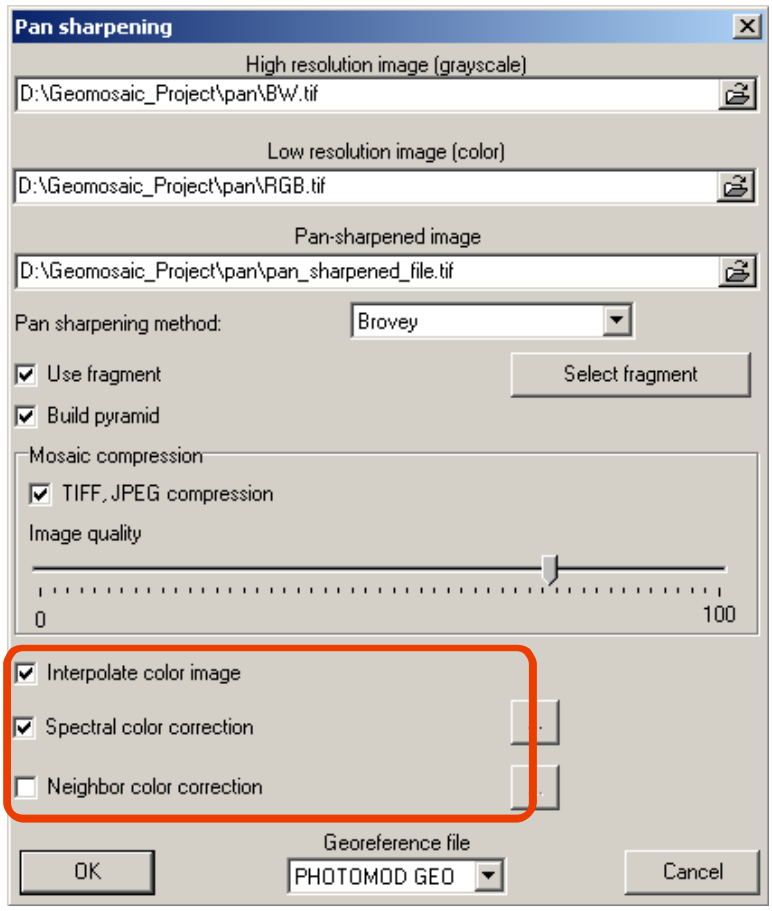


Fig.51 Color balance parameters

The checkbox **Interpolate color image** is marked by default. In this case, color bilinear interpolation in frames of one pixel of initial color raster. It is recommended to use the option in most cases, except those rare ones when the interpolation clearly leads to image sharpness deterioration.

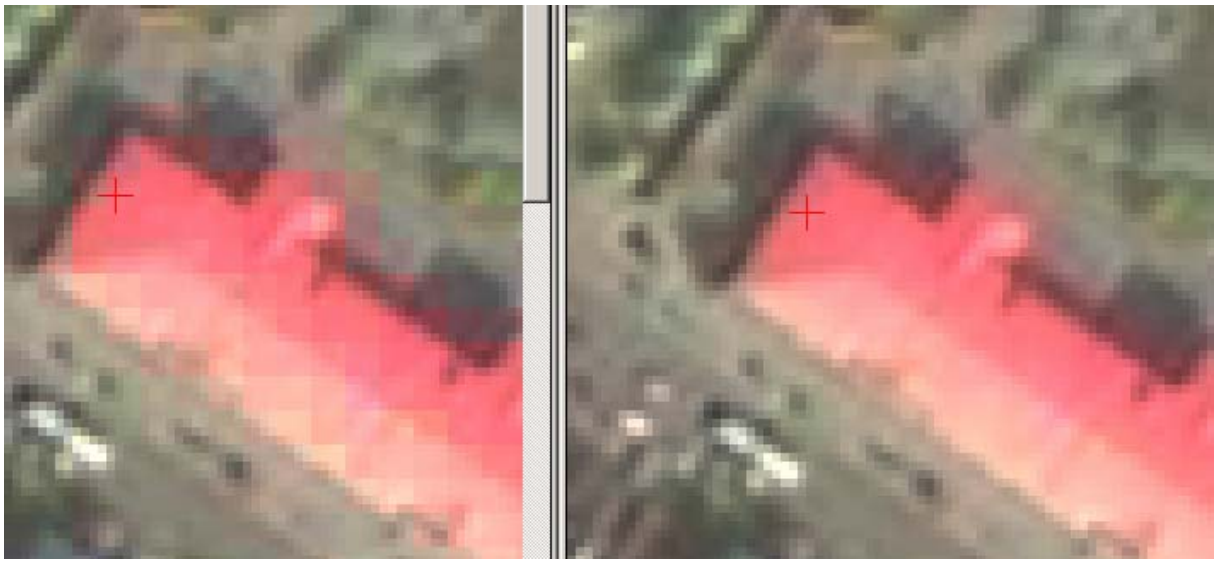


Fig.52 Pan sharpening result using **Brovey** method without interpolation of color image (left) or with interpolation (right)

When the interpolation is not used (the option is **Interpolate color image** cleared), small squares with pixel size corresponding to initial color raster are clearly visible on output image, that is undesirable in most cases.

For some images it would be enough to apply one of two other methods along with interpolation to obtain an acceptable result.

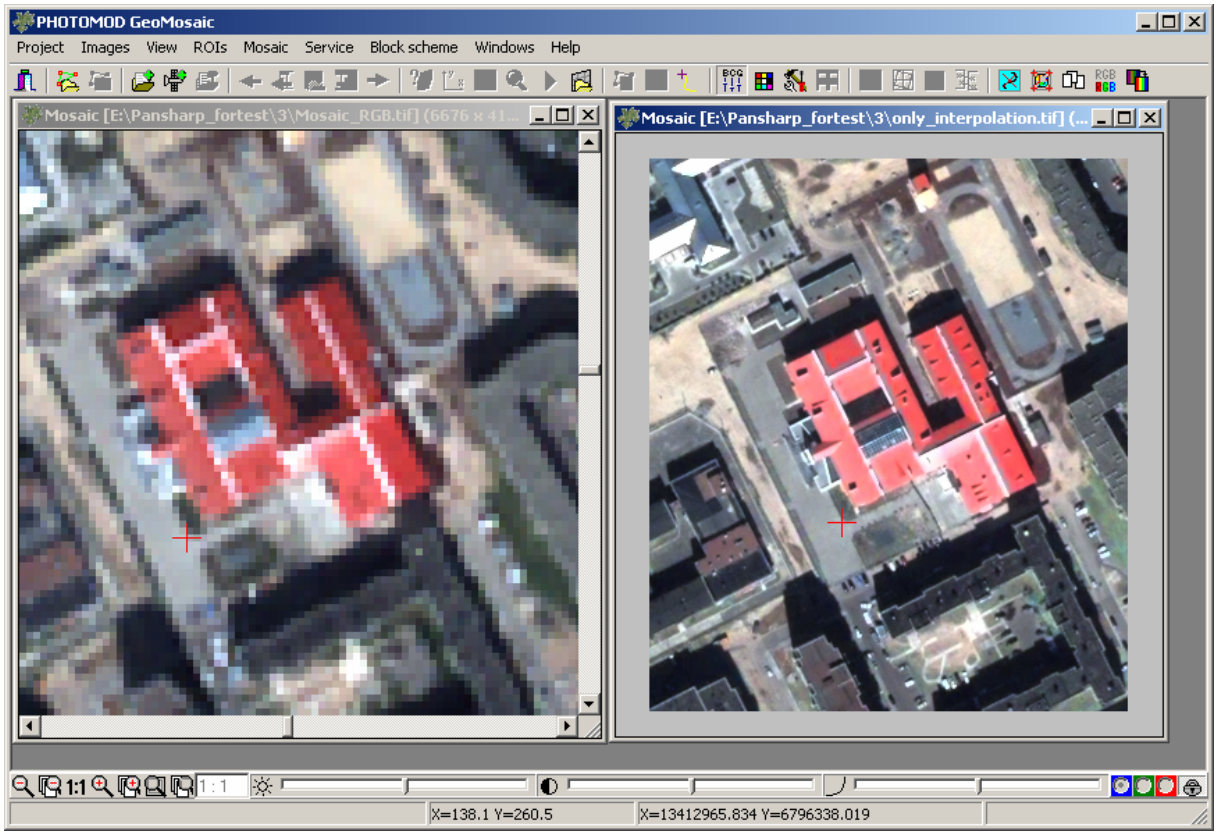


Fig.53 Initial color image (left) and the result of pan sharpening operation by **Brovey** method with color raster interpolation option

Pan sharpening operation leads unavoidably to some distortion of initial colors. Sometimes it is insignificant as shown on the Fig.53 above, and sometimes it is essential enough. For instance, the output image may acquire gloomy grey tint, or vegetation may become bright green too much, etc. In order to correct color during pan sharpening you may use an additional options.

When using the option **Spectral color correction** (see Fig.51) the color of each pixel will be changed to make it maximally similar to the color of appropriate pixel of initial color image without visible deterioration of output image sharpness.

Push the button to open a window allowing to setup parameters of color correction using spectrum.

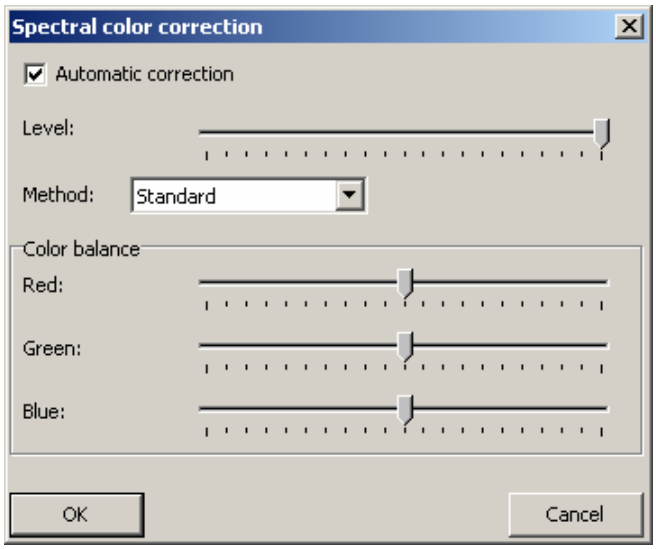


Fig.54 Color correction using spectrum

The window is intended for adjustment of the following parameters:

- When the option **Automatic correction** is on (by default) the spectral parameters of initial raster are analyzed and used for pan sharpening (see Fig.55). At that the color correction level management (using the **Level** slider) becomes available.

- **Level**. Zero percent value (leftmost slider position) turns off automatic correction using color (clears the **Automatic correction** checkbox), hundred percent value (rightmost slider position) – maximal possible correction means that output image get minimal details, but colors will be maximally close to input image colors. Correction level change allows to pass gradually from one of these limits to another. It is recommended to reduce the level when you need to increase a level of details (at that output image often becomes somehow grayish), or to raise the level if you need to enhance color rendering.

- **Method**. Is used both with automatic correction and without it. When using the **Equalization** method the color which is linear combination of color pixel on input color raster and corrected color is assigned to each pixel. It allows to approximate resulting image color to initial one, along with smoothing of black-and-white image contrast. At that some blurriness of resulting image details may occur.

- **Clear hue brightness** – correction parameters used both with automatic correction and without it. The example of these controls use is brightness decreasing of vegetation green color (see Fig.56, 57). Each of three sliders influences on color correction in the area where the value of an appropriate channel prevails. I.e. the **red** slider adjusting results in visualization of red areas on pan-sharpened image, the **blue** slider – for blue areas, the **green** one – for green. Generally it leads to change of color value of selected channel, but it could not be considered as usual monotonous brightness change. When the parameter value is less than 0.5 the appropriate brightness it will be decreased, if it is more than 0.5 – it will be increased. If brightness of some color is setup it its average value (the slider position is in 50%), this color channel will be not corrected.

Fig.55 Initial color image (left), pan sharpening operation result by **Brovey** method without color correction (in center), with automatic correction (right)

Fig.56 Initial color image (left), pan sharpening operation result by **Brovey** method without color correction (right)

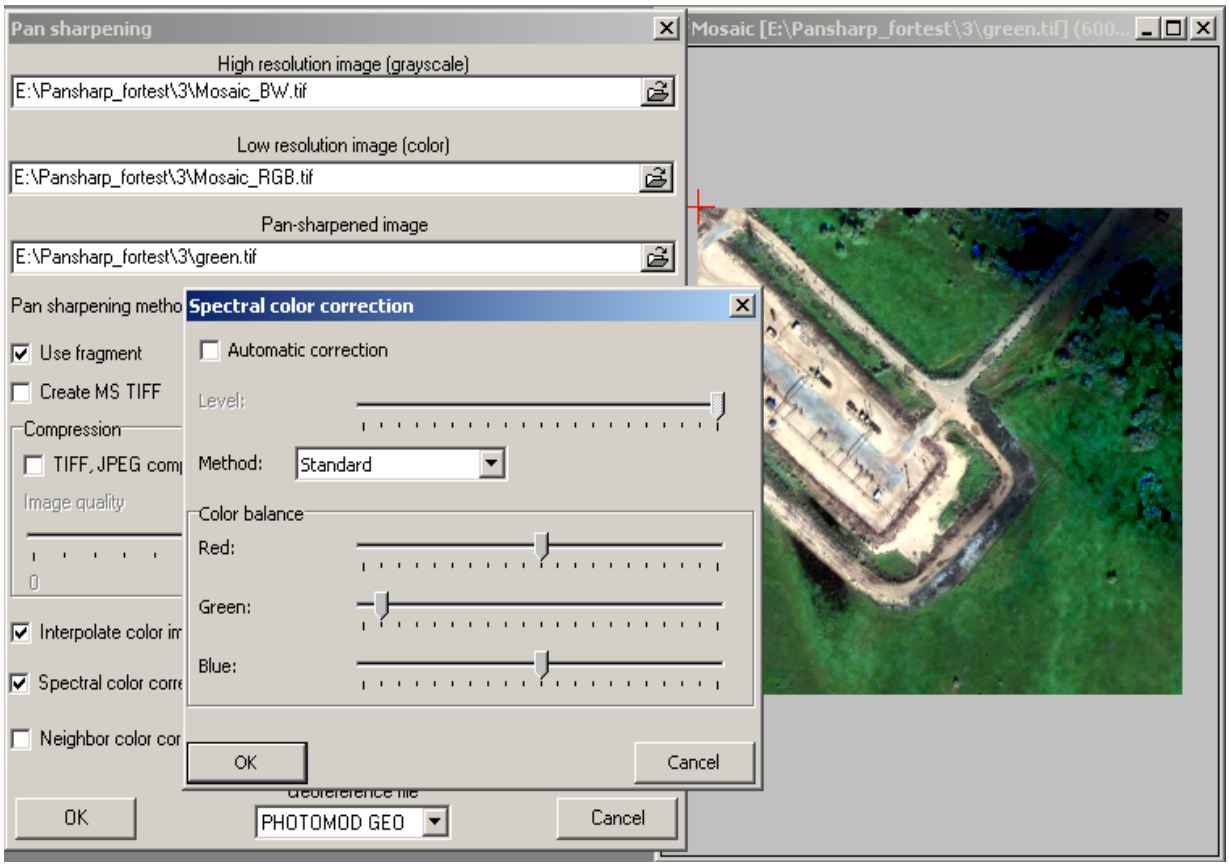


Fig.57 Result of the same operation when the green color brightness is reduced

In some cases you can use the option **Neighbor color correction** (see Fig.51). At that each pixel of color image gets its color from an average color of its neighbors considering weight coefficients. Neighbor color correction algorithm is also helpful when it is necessary to obtain an image with objects of more similar color, and also for images with poor georeference, when there is noticeable shift of objects on color and b/w images. In this case the correction may result in some sharpening of objects' contours (see Fig. 60).

Push the button to open the following window to setup parameters of neighbor color correction process.

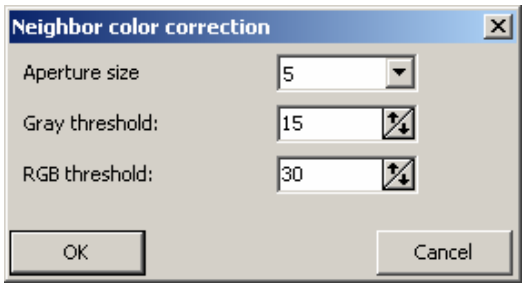


Fig.58 Neighbor color correction parameters

The window is intended for adjustment of the following parameters:

- **Aperture size** – size of neighboring area around pixel to be processed measured in pixels of color raster. For instance, Fig.59 shows that hatched pixel is surrounded by 3x3 pixels area, which color values will be used for measuring of central pixel color. So the aperture in this case is 3. Maximal allowed aperture size is 9.

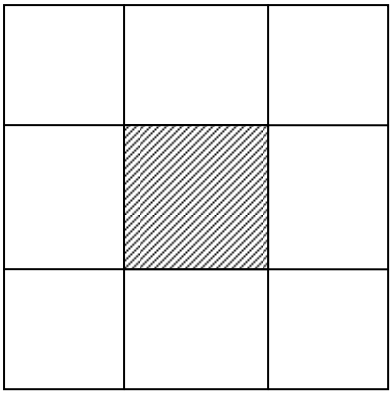


Fig.59 Aperture size around pixel with color to be defined

- **Grey threshold** – averaging is performed only for those pixels where grey color intensity in appropriate pixels of b/w raster differs from the current pixel intensity not more then for the threshold defined.

- **RGB threshold** – averaging is performed only for those pixels where the value of each channel differs from the value in the current pixel not more then for the threshold defined.

Color intensity thresholds may vary from 0 to 255. If the threshold value is 255 (maximal value) averaging will be executed in the whole neighborhood.

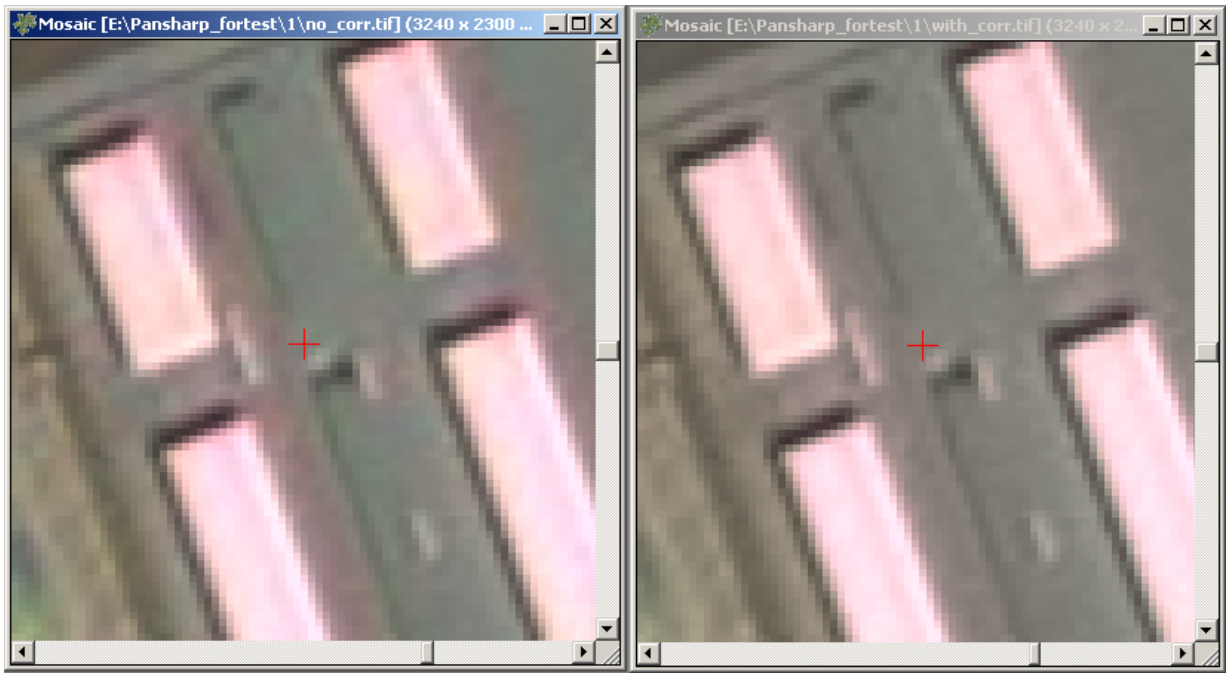


Fig.60 Pan sharpening operation result by **Brovey** method without color correction (left) and using neighbor color correction (right)

When using default parameters you will get only insignificant color correction, almost unnoticed for eyes. On example shown on Fig.60 are used the following settings: aperture size – 7, grey threshold – 25, RGB threshold – 70. The option **Neighbor color correction** is off by default. When the thresholds have big values the aureole around objects may appear when using this option, and also the color of whole image may worsen.

Note: it is recommended to use the Neighbor color correction option very carefully. Along with image improvement in some part of image, it would result in quality worsening in other parts

14. Coordinate system transformation

Coordinate system could be selected both for initial images and for resulting mosaic if necessary. The coordinate system transformation is started on **Mosaic** tab in **Preferences** window (see the chapter 8.1 Mosaic) if the option **Set coordinate system** is **ON**. Push the button ... and open the window used for changing the initial coordinate system of mosaic project.

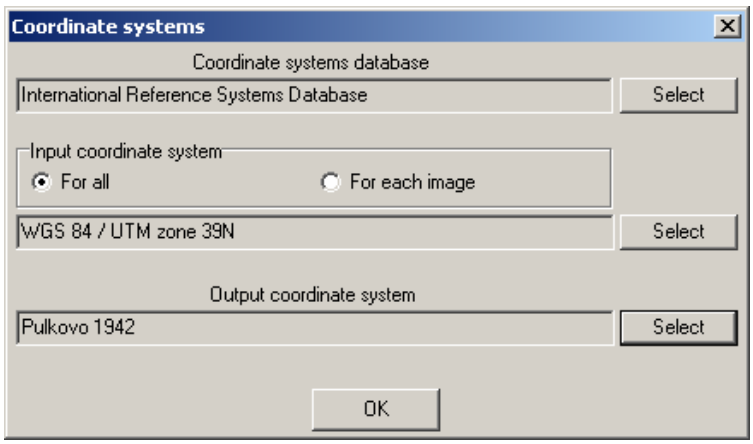


Fig.61

Upper field of this window is intended for selecting of coordinate systems database from set of databases included to **PHOTOMOD GeoMosaic**, and opened after pushing the **Select** button.

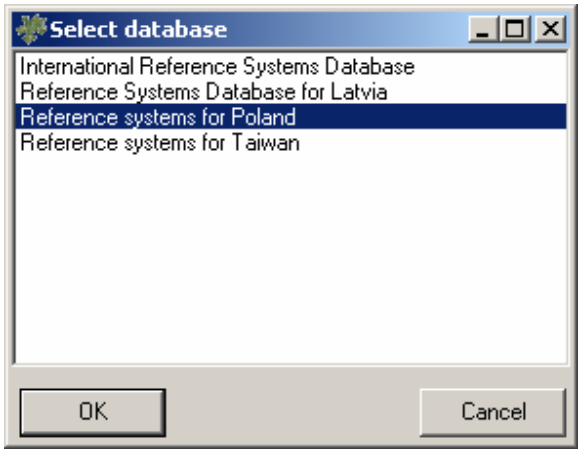


Fig.62

After that select coordinate system of initial images in the **Input coordinate system** field. If initial images are linked to different coordinate systems, choose appropriate coordinate system for each image individually or for all images of the project, by selecting options **For each image** or **For all**. When choosing coordinate system for individual image, push the **Select** button and select individual image and its coordinate system (by the button CS) in opened window with list of project images.

Coordinate system selection and working with it including creating new one in opened window is described in the chapter 16 Coordinate systems.

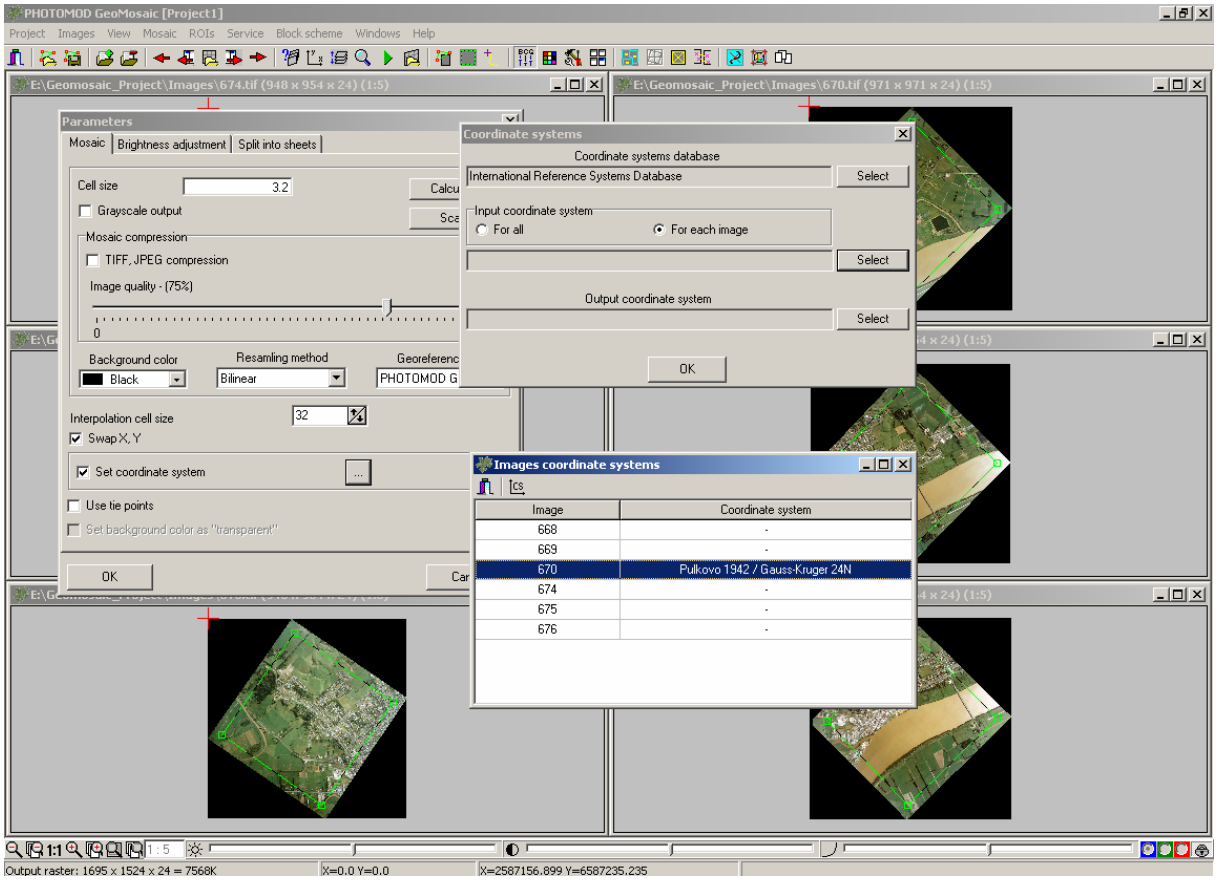


Fig.63 Coordinate system selection for the individual image

Then in the window **Coordinate systems** select output coordinate system in the same way (by pushing the button **Change** in **Input coordinate system** field) for referencing the resulting mosaic.

Once all the above parameters are setup push **OK** button to start coordinate system transformation.

Note. You can specify path to coordinate system database manually, it is stored by default in the following folder C:/Program files/PHOTOMOD GeoMosaic/CoordSys

15. Georeference file

When the mosaic file is created the georeference file is saved to the same folder. This file is used for referencing the mosaic to the coordinate system and has formats, described in the chapter 15.1 PHOTOMOD Geo file, 15.2 ArcWorld file and 15.3 MapInfo file. The georeference file format is selected on the tab **Mosaic | Parameters | Mosaic** (see the chapter 8.1 Mosaic).

Note. In case of mosaic export to GeoTIFF, VectOr, MicroStation, ERDAS Imagine the georeference information is stored directly in the file and the separate georeference file is not created

15.1. *PHOTOMOD Geo file*

PHOTOMOD georeference file has **.geo** extension and contains pixel and ground coordinates of 4 mosaic cells as well as cell size by X and Y axes in given units.

Example of geo file:

Mosaic created by PHOTOMOD 10.01.07
Units: (m)
Linscale: 8.600
Colscale: 8.600
(0.5, 0.5) (8271360.000 East, 1857514.200 North)
(0.5, 2446.5) (8271360.000 East, 1836470.000 North)
(2612.5, 0.5) (8293831.800 East, 1857514.200 North)
(2612.5, 2446.5) (8293831.800 East, 1836470.000 North)
Coordinate system: UTM, (North)

15.2. *Arc World file*

Georeference file, used by **Arc INFO** (**.tfw** extension at export to **TIFF** format)
Example of .tfw file:

1.000000
0.000000
0.000000
-1.000000
551286.128054
200588.824470

After mosaic export to other formats georeference files (of text format likewise .tfw file) are created with the following extensions:

After export to **BMP** georeference file with **.bpw** extension is created.
After export to **JPG** georeference file with **.jgw** extension is created.
After export to **NITF** georeference file with **.nfw** extension is created.
After export to **DGN** georeference file with **.dgw** extension is created.
After export to **PNG** georeference file with **.pgw** extension is created.

15.3. *MapInfo file*

Georeference file, used by **MapInfo** (**.tab** extension)

Example of .tab file:

!table
!version 300
!charset WindowsLatin1

Definition table
File "mosaic.tif"
Type "RASTER"
(143424.937,2635592.133) (0,0) Label "Point 1",
(224834.937,2635592.133) (1163,0) Label "Point 2",
(143424.937,2565592.133) (0,1000) Label "Point 3",

(224834.937,2565592.133) (1163,1000) Label "Point 4"
CoordSys Earth Projection 8, 104, "m", 33.000000, 0.000000, 0.999600, 500000.000000, 0.000000

16. Coordinate systems

16.1. *Selecting coordinate system*

Coordinate systems databases are installed automatically along with **PHOTOMOD GeoMosaic** program. You can use special window to change coordinate system of mosaic project, see the chapter 14 Coordinate system transformation. After database selection you can select coordinate system in the list, edit its parameters (such as cartographic projection, datum, ellipsoid, etc.) or create a new one. See also the chapter 16.2 Coordinate system database, 16.4 Coordinate system editing and 16.5 Coordinate system creating.

Click the **Open** button to open the window with coordinates systems list included to selected base. For the quick search of needed system, input coordinate system name or key word into the **Search** field (fig.64) and choose the search direction: down (the button) or up (the button) the list.

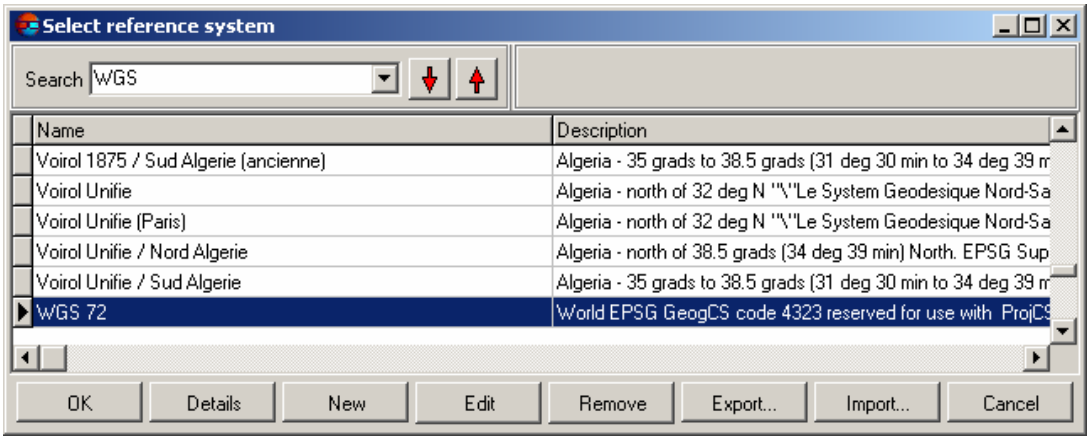

Select reference system
Search
WGS
Name
Description
Voirol 1875 / Sud Algerie (ancienne)
Algeria - 35 grads to 38.5 grads (31 deg 30 min to 34 deg 39 m
Voirol Unifie
Algeria - north of 32 deg N "\"Le System Geodesique Nord-Sa
Voirol Unifie (Paris)
Algeria - north of 32 deg N "\"Le System Geodesique Nord-Sa
Voirol Unifie / Nord Algerie
Algeria - north of 38.5 grads (34 deg 39 min) North. EPSG Sup
Voirol Unifie / Sud Algerie
Algeria - 35 grads to 38.5 grads (31 deg 30 min to 34 deg 39 m
WGS 72
World EPSG GeogCS code 4323 reserved for use with ProjCS
OK
Details
New
Edit
Remove
Export...
Import...
Cancel

Fig.64 Coordinate system database search

The arrow in the leftmost column marks the name of first coordinate system found with the name searched.

You can edit, export or delete the coordinate system selected. And also you can create new one or import existing using an appropriate buttons of this window (see also the chapters 16.4 Coordinate system editing and 16.5 Coordinate system creating).

16.2. *Coordinate system database*

Coordinate systems database includes a list of coordinate systems supported by **GeoTIFF** format used to store georeferenced raster images (standard of **EPSG** – European Petroleum Survey Group).

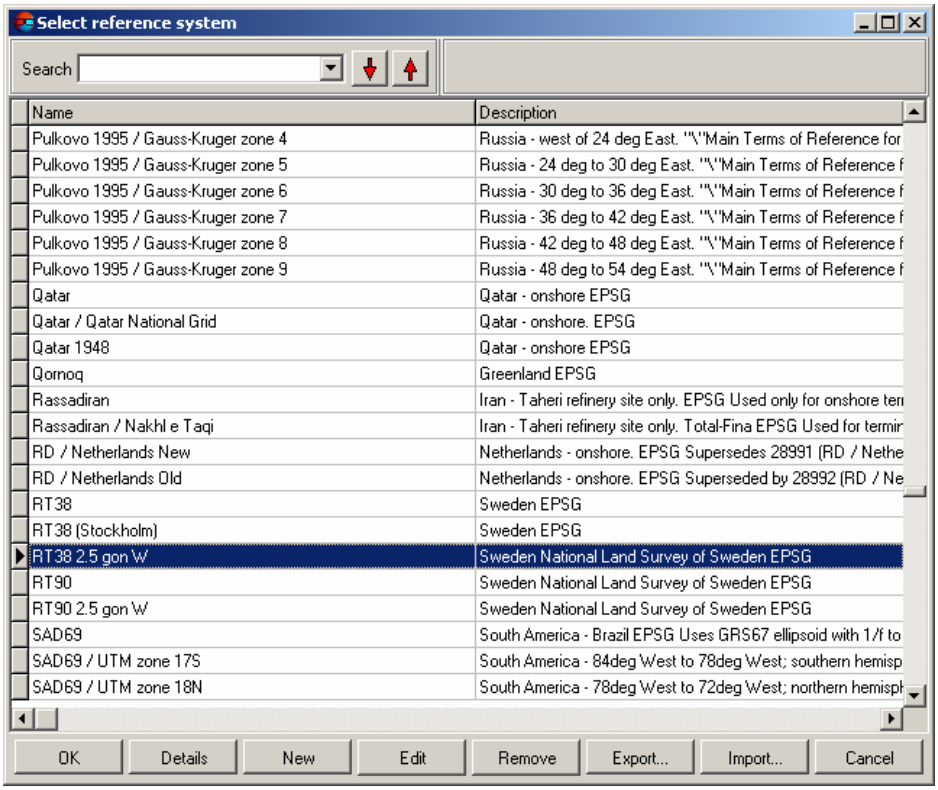

Select reference system
Search
Name
Description
Pulkovo 1995 / Gauss-Kruger zone 4
Russia - west of 24 deg East. "\"Main Terms of Reference for
Pulkovo 1995 / Gauss-Kruger zone 5
Russia - 24 deg to 30 deg East. "\"Main Terms of Reference f
Pulkovo 1995 / Gauss-Kruger zone 6
Russia - 30 deg to 36 deg East. "\"Main Terms of Reference f
Pulkovo 1995 / Gauss-Kruger zone 7
Russia - 36 deg to 42 deg East. "\"Main Terms of Reference f
Pulkovo 1995 / Gauss-Kruger zone 8
Russia - 42 deg to 48 deg East. "\"Main Terms of Reference f
Pulkovo 1995 / Gauss-Kruger zone 9
Russia - 48 deg to 54 deg East. "\"Main Terms of Reference f
Qatar
Qatar - onshore EPSG
Qatar / Qatar National Grid
Qatar - onshore. EPSG
Qatar 1948
Qatar - onshore EPSG
Qornoq
Greenland EPSG
Rassadiran
Iran - Taheri refinery site only. EPSG Used only for onshore ter
Rassadiran / Nakhl e Taqi
Iran - Taheri refinery site only. Total-Fina EPSG Used for termir
RD / Netherlands New
Netherlands - onshore. EPSG Supersedes 28991 (RD / Nethe
RD / Netherlands Old
Netherlands - onshore. EPSG Superseded by 28992 (RD / Ne
RT38
Sweden EPSG
RT38 (Stockholm)
Sweden EPSG
RT38 2.5 gon W
Sweden National Land Survey of Sweden EPSG
RT90
Sweden National Land Survey of Sweden EPSG
RT90 2.5 gon W
Sweden National Land Survey of Sweden EPSG
SAD69
South America - Brazil EPSG Uses GRS67 ellipsoid with 1/f to
SAD69 / UTM zone 17S
South America - 84deg West to 78deg West; southern hemisp
SAD69 / UTM zone 18N
South America - 78deg West to 72deg West; northern hemisph
OK
Details
New
Edit
Remove
Export...
Import...
Cancel

Fig.65 Coordinate systems database

Besides the EPSG database there are **Cartesian** (on the plane) and **Local** (the Earth is approximated by sphere) coordinate systems added. The Cartesian coordinate system is used for relatively small blocks of large scale aerial images. The coordinate systems are created separately for each zone. So if you have a project covering several zones all ground control point coordinates must be recalculated to the coordinate system of one zone. The name of coordinate system looks like **NAD83 / UTM zone 30N**, where NAD83 is a datum, UTM is a coordinate system, 30 is a number of zone and N is a hemisphere (north).

Select the coordinate system and click **OK** button to assign it to the project. See also the chapter 16.4 Coordinate system editing.

16.3. *Types of coordinate systems*

Coordinate system types (the list is open by the **New** button of **Select reference system** window) are as follows:

- **Geocentric** – coordinate system with the origin in the mass center of the Earth. At that Z axis is oriented to the North pole, X axis to the intersection point of Greenwich meridian and equator, and Y axis to the East
- **Latitude / longitude** – geographic (latitude / longitude / height) coordinate system
- **Local Cartesian** – coordinate system on the plane
- **Local curved** – coordinate system on the sphere
- **Projected** – coordinate system defined by the map projection
- **Topocentric horizontal** – coordinate system with the origin in the selected space point. At that X axis lies in the plain of origin meridian, Z axis lies on ellipsoid surface normal in origin, and Y axis is oriented in the following way: in left coordinate system it is Eastward, and in right – Northward.

Note. PHOTOMOD GeoMosaic does not work with Geodetic coordinate systems, so if you need to process such data you should convert ground control points coordinates

to selected Projected coordinate system using Geodetic calculator included to the PHOTOMOD GeoMosaic installation kit (see the chapter 17 Geodetic calculator***)***

16.4. *Coordinate system editing*

In very most cases you need just pre-defined coordinate systems included to the database. Nevertheless **PHOTOMOD GeoMosaic** provides all necessary tools for editing coordinate system parameters. For example you want to change the ellipsoid in UTM coordinate system from NAD 83 to WGS 84. For this purpose you should:

- open coordinate system database
- select coordinate system (for example **NAD83 / UTM zone 30N**)
- push the **Edit** button
- select **Ellipsoid** option in the opened window and push the ... button at the left
- select **WGS-84** ellipsoid in the list appeared
- push **OK**

In the same way you can change all other coordinate system parameters such as datum, map projection, ellipsoid parameters and so on (see also the chapter 16.5 Coordinate system creating).

16.5. *Coordinate system creating*

Let's consider a sample of coordinate system creation. For example you need to create a coordinate system in Transverse Mercator map projection for the area of 8th zone (origin meridian 136 degrees) of the north hemisphere on the ellipsoid WGS-84. In this case do the following:

- open a window of coordinate system database selection (**Project | New | Coordinate system** or **Project | Properties | Coordinate system**)
- select coordinate system database
- push the **New** button in appeared window, which contains the list of available coordinate systems
- select reference system type as **Projected** (**Select reference system type** window)

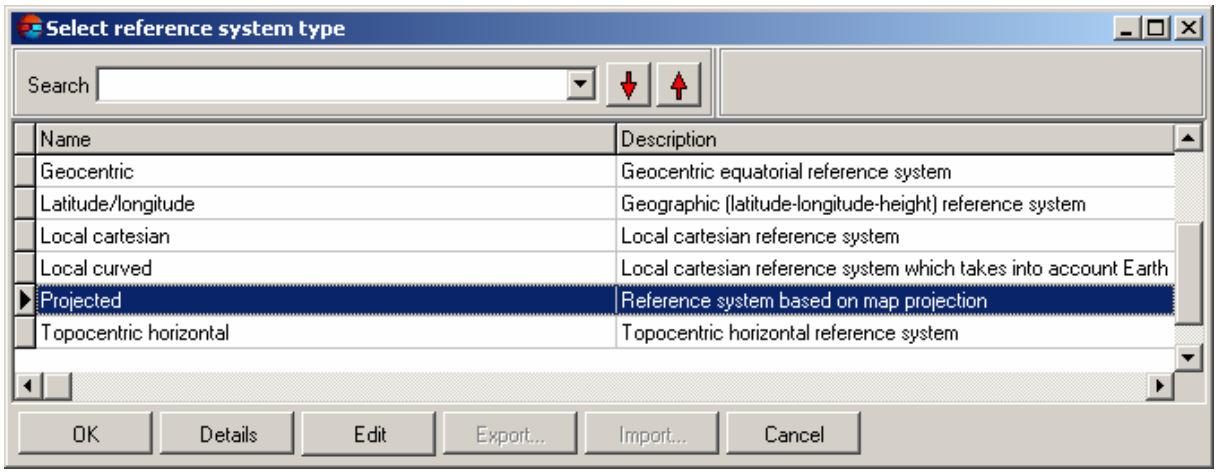


Fig.66 Coordinate system type selection

- push **OK**
- fill out the following fields of **Edit projected reference system** window:
  - **Name** – arbitrary name (for example UTM, 8N zone)

- **Abbreviation** – arbitrary short name
- **Description** – arbitrary description
- **Datum** – select datum **World Geodetic System 1984**, (**WGS 84** ellipsoid will be displayed in **Ellipsoid** field automatically)
- **Prime meridian** – select **Greenwich** from the list
- **Linear units** – select **Meters** from the list
- **Axis names** – set names for axis as **E**, **N**, **H**

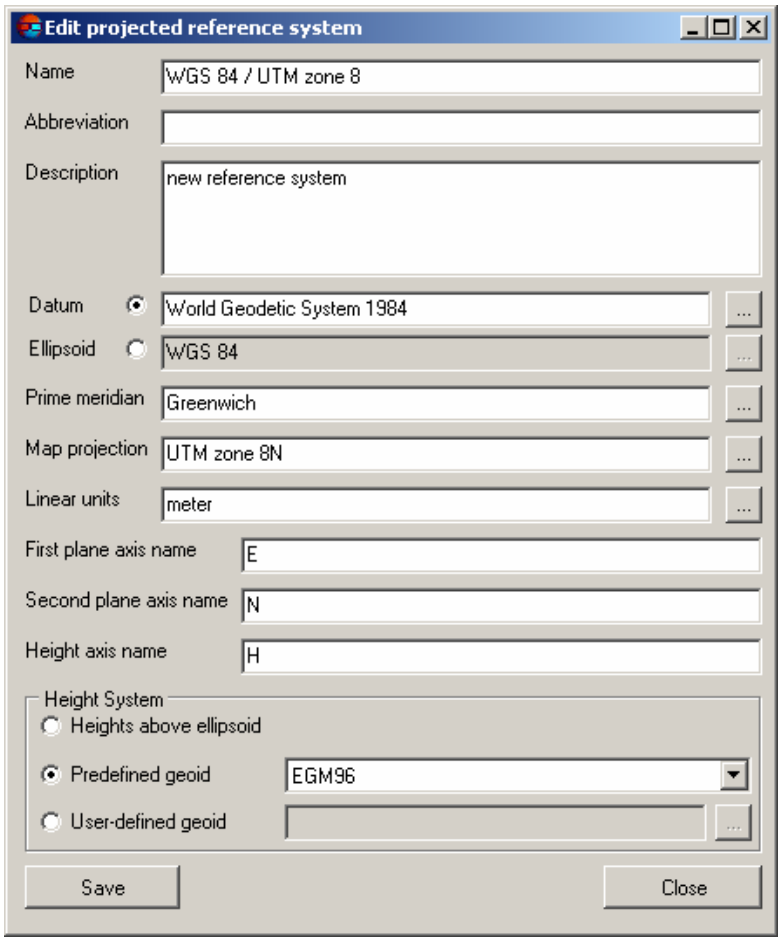


Fig.67 Coordinate system parameters

- Push the ... button in **Map projection** field and select **UTM zone 8N** in **Select map projection** window

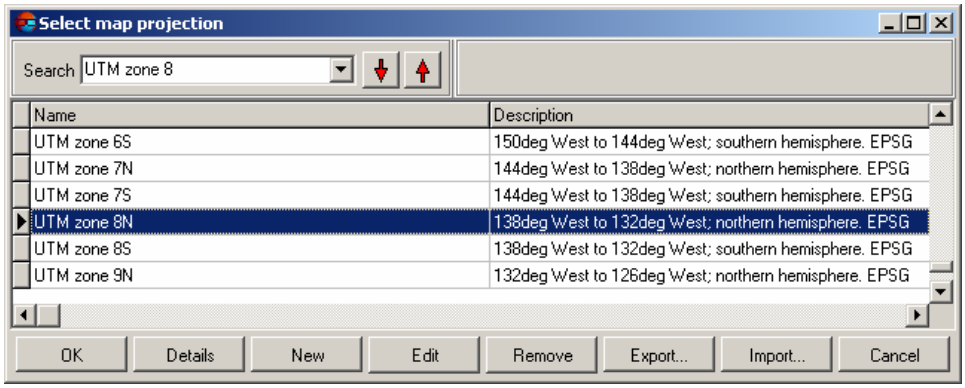


Fig.68 Map projection selection

- Push **OK**

PHOTOMOD GeoMosaic module includes parameters of predefined geoid (**EGM-96** – Earth Gravity Model-1996) you may need to recalculate height system of your GeoMosaic project. Mark this option in the **Height system** panel to use this geoid to set heights in coordinate system. There is also an opportunity to set up heights using user-defined geoid.

You can also set map projection parameters manually. In this case push the **New** button in the **Select map projection** window.
Select the following parameters in **Edit map projection** window:

- Push the ... button in **Projection type** field and select UTM (6 degree zones) in the list appeared
- Click **hemisphere** field and select N (Northern) in drop-down list
- Click **zone** field and select 8 in drop-down list

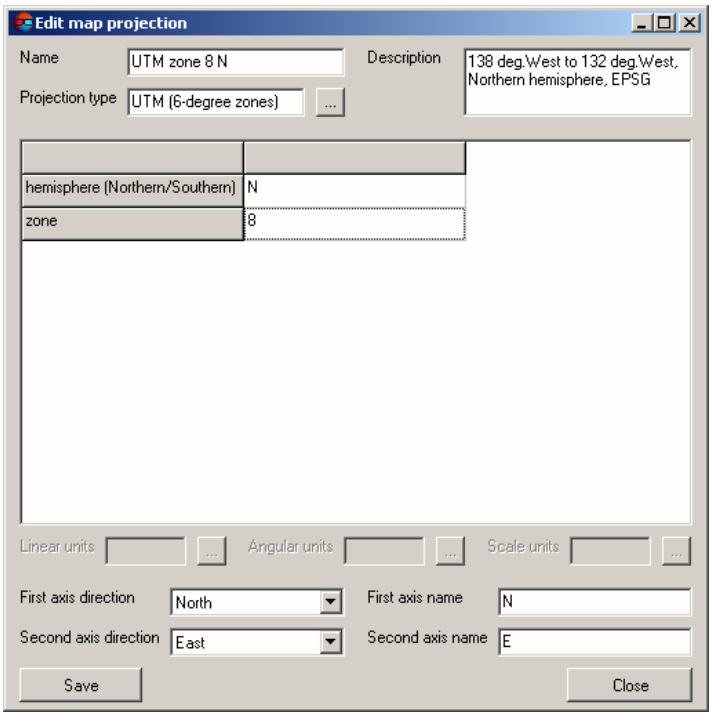


Fig.69 Creating map projection

Note. Do not input zone number while editing or creating map projection, since it is included to Reference system name (see Fig.60, 61)

Another way to select map projection is to use Transverse Mercator projection with full list of parameters. In this case you should set the following values in **Edit map projection** window:

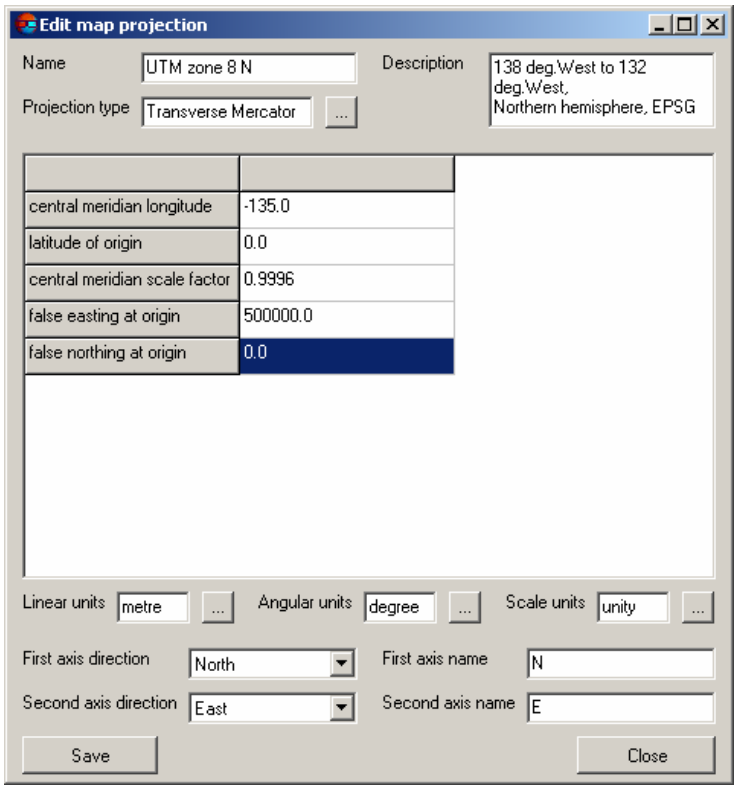


Fig.70 Creating map projection

- **projection type** – Transverse Mercator
- **central meridian longitude** – -135.0
- **latitude of origin** – 0.0
- **central meridian scale factor** – 0.9996
- **false easting at origin** – 500000.0
- **false northing at origin** – 0.0

In case of selecting **Projection type** as **UTM (6 degree zones)** these parameters are set automatically, so this sample just shows the system flexibility.

17. Geodetic calculator

An additional **PHOTOMOD GeoMosaic** system utility, intended for recalculating of ground control points coordinates from one coordinate system into another.

Geodetic Calculator is running from OS Windows Start menu: **Start | Programs | PHOTOMOD GeoMosaic | Geodetic calculator**.

At first program launch you should specify the path to folder containing coordinate systems database in the following window.

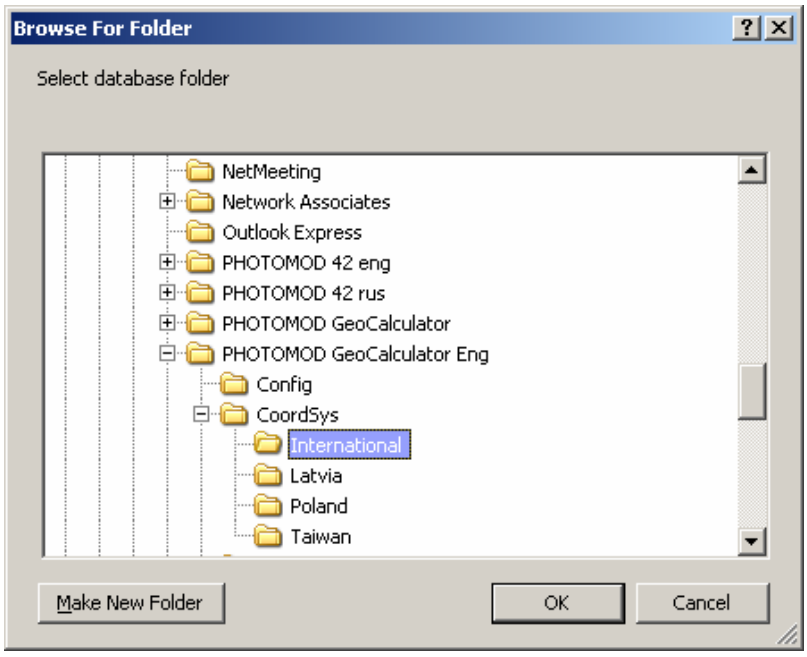


Fig.71 Selection of folder with coordinate system database

Then the dialogue of the program settings is opened, (also could be opened using menu command **Tools | Options**, or the icon **Options**). Upper panel of the window – **Database directory** – shows the folder selected, and allows to change the path to database directory if needed.

If coordinates calculations have poor result the field with invalid value is shown in red color (by default) or by color selected in drop-down list of **Colors** panel.

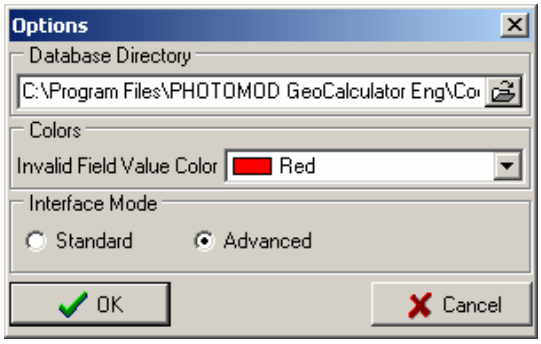
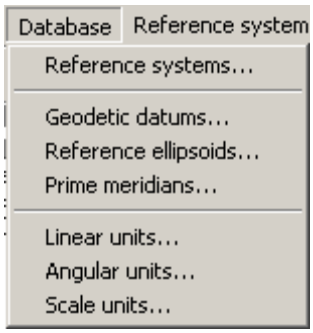


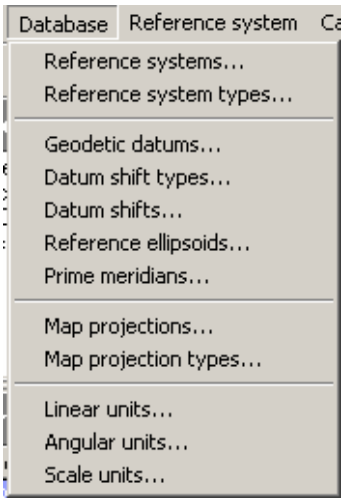
Fig.72 Program settings

Interface mode panel allows to select one of two working modes: **Standard** and **Advanced** which have different set of menu commands (appeared after pushing **Database** menu item) for work with coordinate systems database. See also the chapter 16 Coordinate systems.

Standard set of **Database** menu contains the following items:



Advanced set of **Database** menu contains the following items:



After pushing **OK** in **Options** window the main **PHOTOMOD GeoCalculator** window is opened.

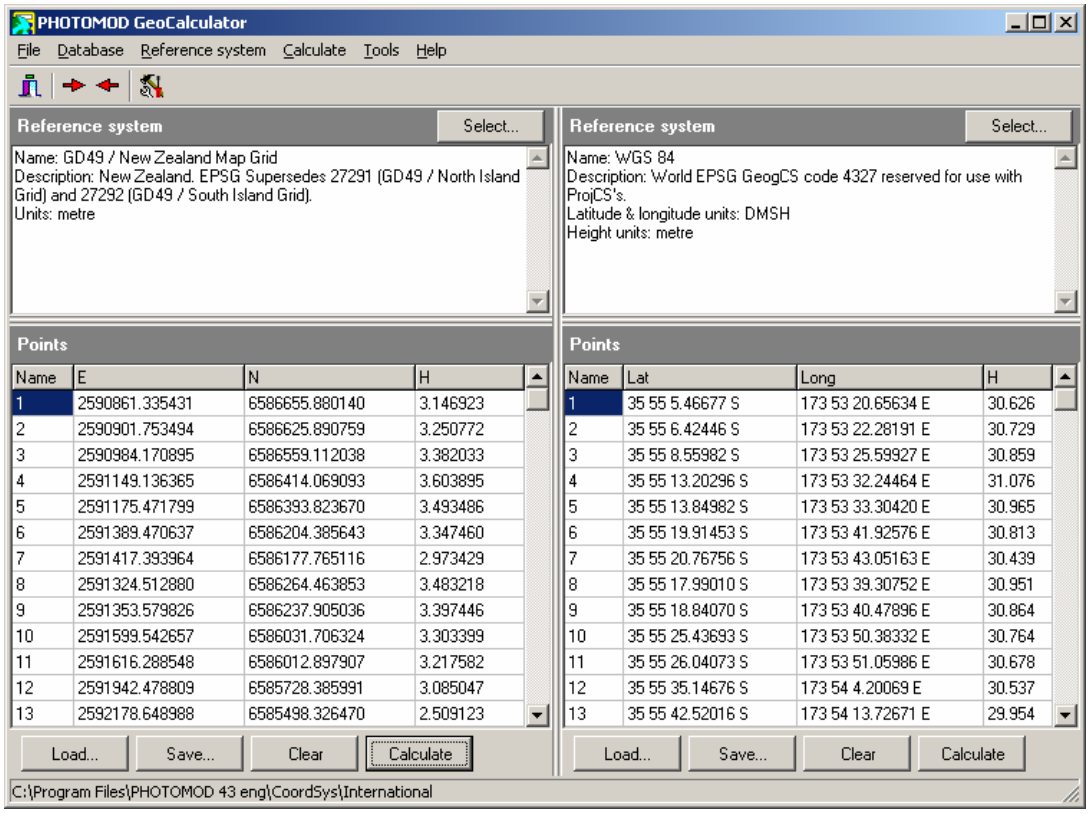


Fig.73

For example, you have initial GCP coordinates set in geodetic coordinate system (Lat, Long, H). To re-calculate them into Cartesian you should do the following.

Push the **Select** button in **Reference system** field of the left panel (or **Ctrl-L** hot keys) and select appropriate coordinate system in which input GCP's were measured. Then load ASCII file with points coordinates (use the **Load** button in **Points** field, or **Ctrl-Alt-L** hot keys).

In the right panel in **Reference system** field exactly in the same way you may select the resulting coordinate system (from Cartesian ones available) and recalculate the coordinates (use the **Calculate** button under right **Points** field or the icon **Calculate from left to right**). After that, in the right **Points** field new GCP coordinates appear. Save the result (use the **Save** button under right **Points** field) in txt file and use it in further work with **PHOTOMOD** project.

Operations of point's coordinates selection and recalculation may be performed both from left to right panel (as described above) and vice versa – from right to left panel. In the latter case use the icon **Calculate from right to left**.

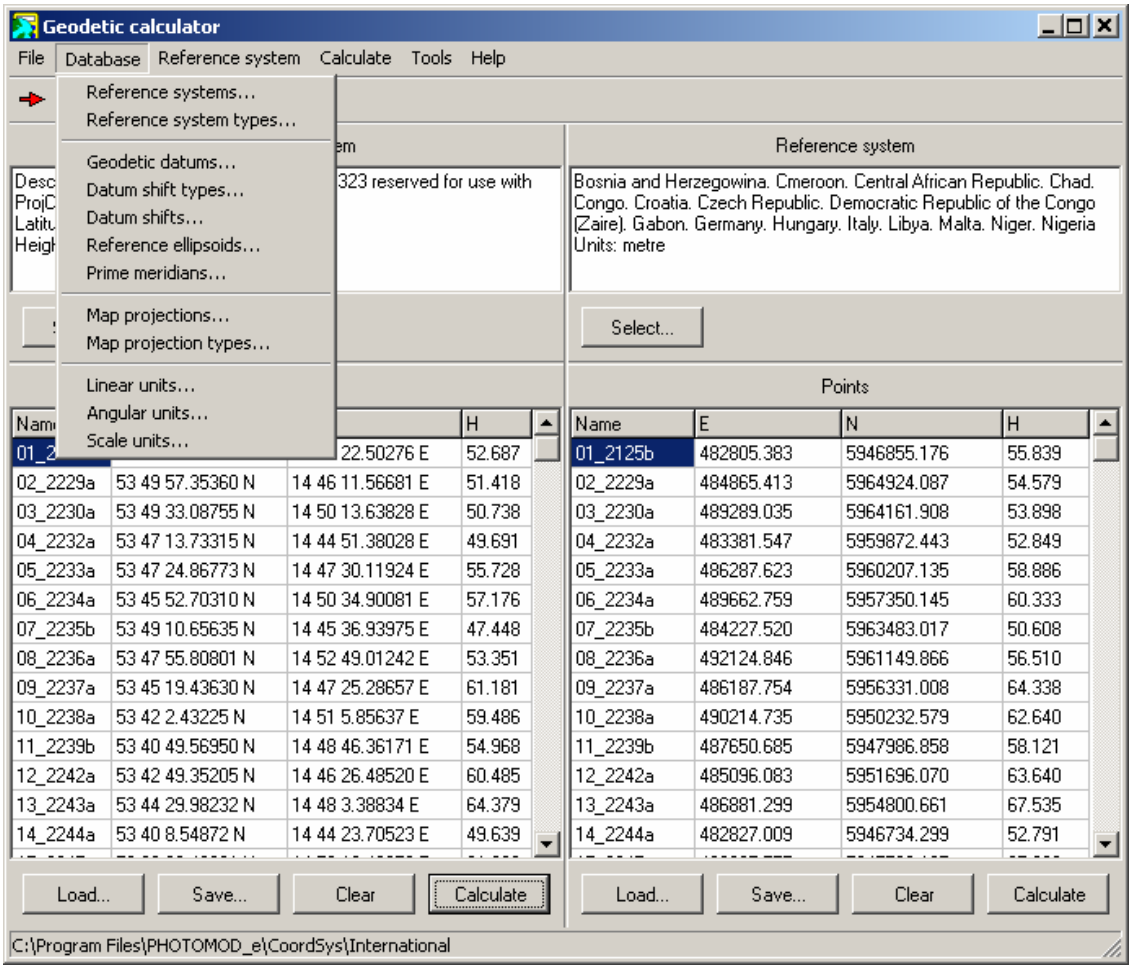


Fig.74

Besides, **PHOTOMOD GeoCalculator** allows to view, select, edit and also export/import coordinate systems databases using main menu item **Database** (Fig.74). See also the chapter 16 Coordinate systems.

18. PHOTOMOD MSTiff Maker utility

In some cases when you create the projects with big number of images located on different media and which occupy a huge disk space, it is convenient to transfer them into **PHOTOMOD MSTiff** format even prior to new project creation. This format allows to speed up the access to the initial raster image and also to save disk space. For such transfer use the utility, opened by the following command: **Start | Programs | PHOTOMOD GeoMosaic | Utilities | PHOTOMOD MSTiff Maker**.

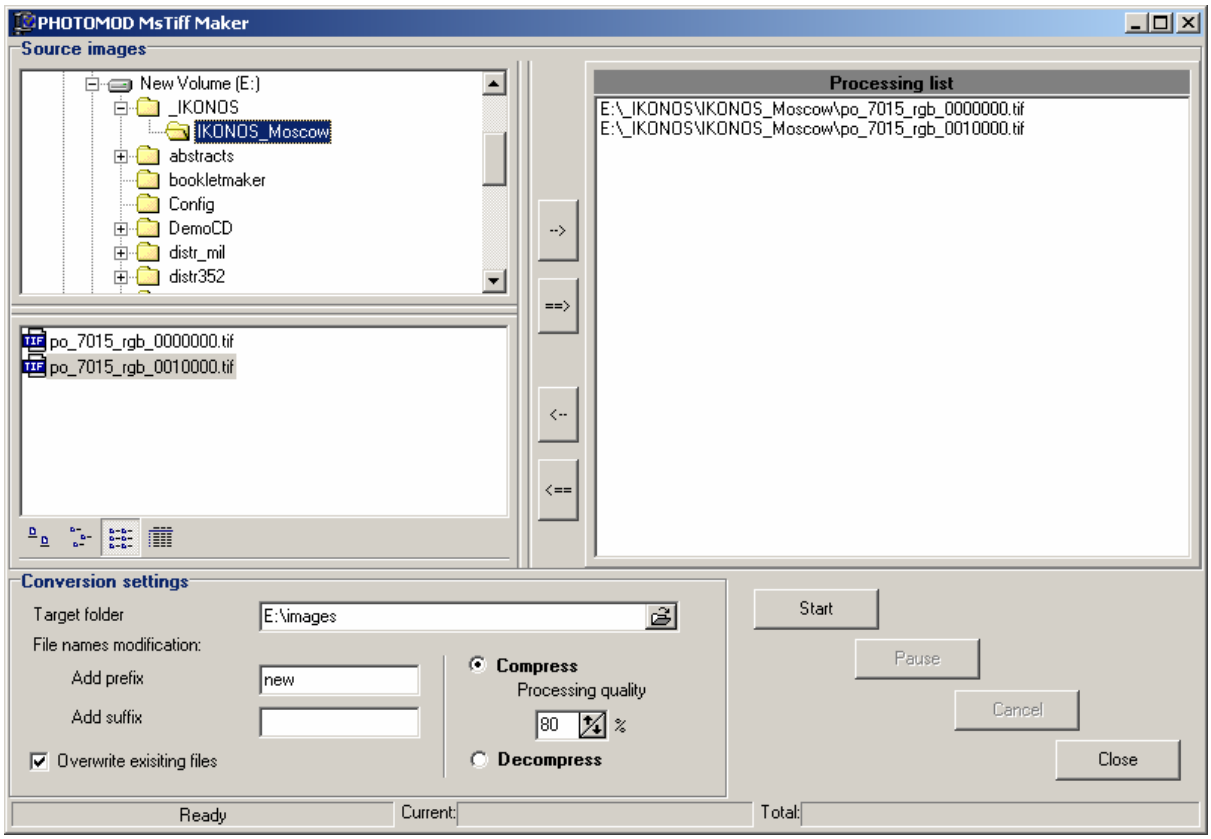


Fig.75 MSTiff Maker window

In **Source images** window select the folder with images (upper window) and Tiff files stored there (lower window). You can add/exclude images files from **Processing list** window using arrow buttons located between the windows. Click these buttons to collect the set of images from different folders/computers to convert them afterwards in **PHOTOMOD MSTiff** format.

The **Conversion settings** panel allows to set up the following parameters of image conversion:

- **Target folder** – pop-down list to select the folder for resulting images storing;
- **File names modification** – to add name prefix (**Add prefix** field) or suffix (**Add suffix**) to images names group;
- **Compress %** – to specify initial images compression level after the conversion, 80% – by default;
- **Decompress** – to allow decompressing of compressed images while converting.

If target folder already contains files with the same names, you can overwrite them by new ones turning on the **Overwrite existing files** option.

The buttons **Start**, **Pause**, **Cancel**, and **Close** are used for converting process management and **Ready**, **Current** and **Total** fields – to view the process state.

19. PHOTOMOD ImageProcessor

The application (opened by pushing the button on toolbar or by menu command **Service | ImageProcessor**) is intended for radiometric correction and geometric transformations of raster images or their fragments, and also includes saving and printing options.

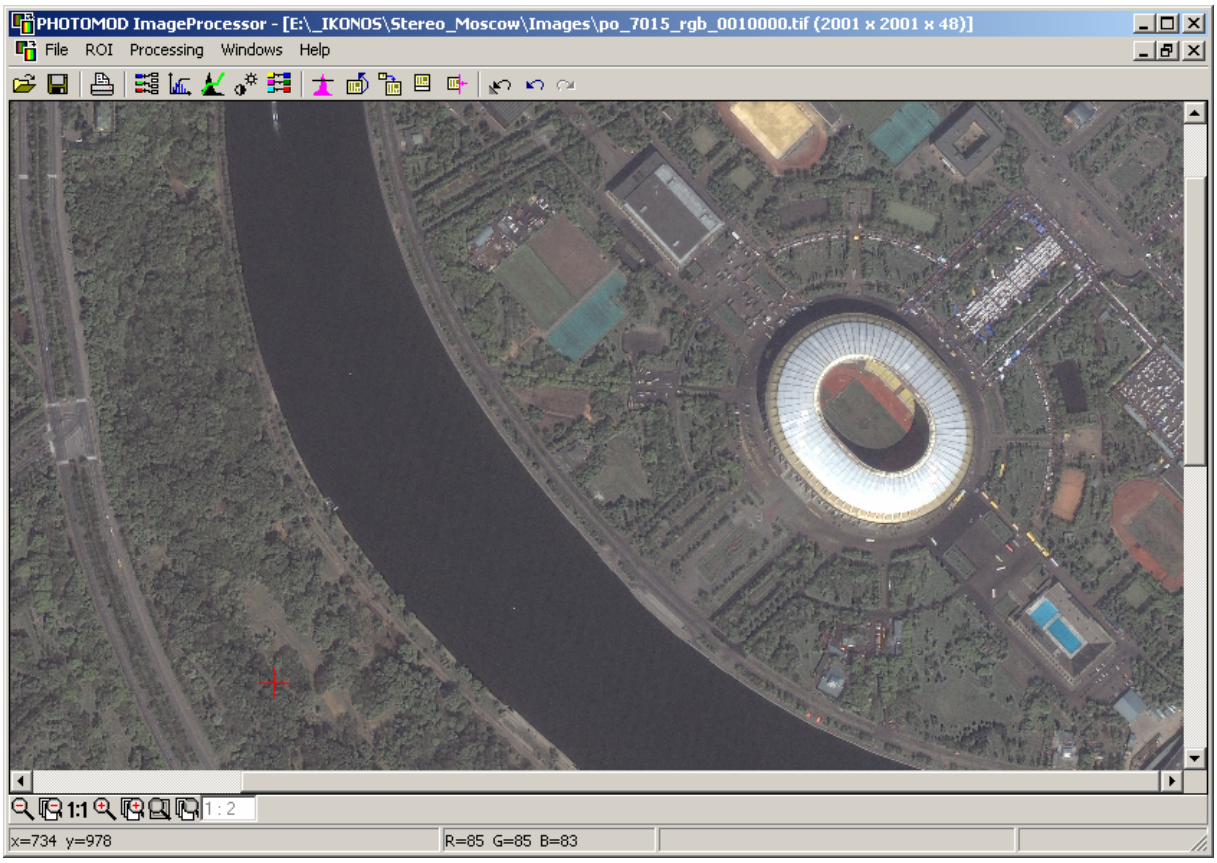


Fig.76 **PHOTOMOD ImageProcessor** utility window

19.1. *Menu commands*

Main menu contains the following items and commands.

File – used to open, save, print and close images, and contains the following commands:

- **Open** (duplicated by the button) – opens file in raster format (listed below) in the application window
- **Save** – saves the image without changing its name and format
- **Save as** (duplicated by the button) – saves the image in selected format considering user's settings, see the chapter 19.3.6 Image saving
- **Close** – closes active image window
- **Close all** – closes all image windows
- **Print** (duplicated by the button) – opens a window to setup and start printing of active window image (see the chapter 19.3.5 Image printing)
- **Exit** – closes application window.

ROI – used for operations with raster image fragment (see the chapter 19.3.4 Operations with image fragment) and contains the following commands:

- **Copy** (duplicated by **Ctrl-C** shortcut) – copies selected ROI to clipboard

- **Paste as new image** (duplicated by **Shift-Ctrl-V** shortcut) – pasts selected ROI to new window
- **Full image** (duplicated by **Alt-Enter** shortcut) – shows image in window at full
- **Delete** (duplicated by clicking the **Delete** button) – cancels fragment selection and deletes its frame

Processing – used for image transformations (see the chapter 19.2.1 Radiometric correction, 19.2.2 Geometric transformations) and contains the following commands:

- **Color channels** (duplicated by the button)
- **Auto levels** (duplicated by the button)
- **Curves** (duplicated by the button)
- **Brightness-Contrast-Gamma** (duplicated by the button)
- **Color balance** (duplicated by the button)
- **Filters** (duplicated by the button)
- **Rotate-Flip** (duplicated by the button)
- **Resize** (duplicated by the button)
- **Raster expansion** (duplicated by the button)
- **Trim edges** (duplicated by the button)
- **Undo all** (duplicated by the button) – cancels all performed operations
- **Cancel** (duplicated by the button) – cancels the last operation
- **Redo** (duplicated by the button) – cancels the last undo operation
- **Batch** – opens a window used to process a set of images, see the chapter 19.2.3 Batch processing.

Windows – used for windows location management and contains the following commands:

- **Cascade** – displays windows stacked and cascading from the upper left to the lower right of the screen
- **Tile vertically** – displays windows edge to edge vertically
- **Tile horizontally** – displays windows edge to edge horizontally
- **Minimize** – displays all opened windows minimized along the bottom of the screen.

Help – contains the following commands:

- **Contents** (or **F1** key) – opens **Help** file.
- **About…** – opens a window with information related to version number, serial number, date of version compiling, etc.

19.2. *Image zooming tools*

At the lower left part of the window there is a set of buttons used for raster image scale management:

- - one step zooming out (duplicated by "**/**" key)
- - one step zooming out (duplicated by "**/**" key) for all images opened
- - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by "**Alt-1**" keys)
- - one step zooming in (duplicated by "*****" key)

- - one step zooming in (duplicated by "*****" key) for all images opened
- - fitting the whole image into the window (duplicated by "**Alt-Enter**" keys)

Mouse wheel steering is also used for image zoom in / zoom out.

Current image zoom is shown in window title bar in brackets after image name and in the lower part of the window as .

You can move image in window in panning mode by mouse along with pressed **Alt** key.

19.3. *Work in application*

Open an image in application window by the button (or select menu command **File | Open**), that allows to load a raster of one of the following formats:

- **Tag Image File Format (TIFF)**
- **Windows Bitmap File (BMP)**
- **VectOr (SIT, RSW, MTW)** – raster format of **PHOTOMOD VectOr** and Panorama systems (see the chapter 12 Export of mosaic to PHOTOMOD VectOr)
- **GeoTIFF** – TIFF format, containing special tags with georeference data
- **ERDAS IMAGINE (IMG)** – raster format of ERDAS system
- **NITF (NITF)**
- **JPEG (JPEG)**
- **GIF (GIF)**
- **PNG (PNG)**
- **PCIDSK (PIX)** – raster format with georeference data in its header, developed by PCI Geomatics
- **JPEG2000 (JP2)** – raster format with jpeg-compressing and georeference data in its header, output image in this format has volume limited up to 500 Mb
- **USGS DEM (DEM)**

Image processing includes radiometric correction operations (see the chapter 19.3.1 Radiometric correction) and geometric transformations (see the chapter 19.3.2 Geometric transformations).

19.3.1. Radiometric correction

You can process the image opened radiometrically using buttons of toolbar (see the chapter 19.1 Menu commands) or commands of menu item **Processing**, see the description of operations in the chapter 7.1.1.1 Image radiometric correction.

19.3.2. Geometric transformations

The application provides the following geometric transformations of an image:

1. **Rotation-flipping** (using menu command **Processing | Rotate-Flip**) – the operations is used for image rotation at 90, 180 or 270 degrees clockwise using buttons of the toolbar opened.

Fig.77 Rotate-flip tools

The buttons and of this toolbar allow to flip image vertically or horizontally correspondingly. Use the buttons and to cancel all or the last of performed actions correspondingly.

2. **Image resizing** (using menu command **Processing | Resize**) – the operation is used to change a raster size in width and height along with resampling operation. In the dialogue opened you can input a resize value and its units (pixels or percent), and select resampling method from drop-down list.

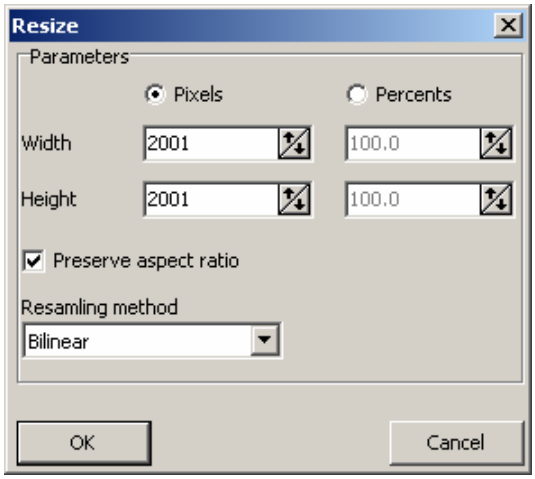


Fig.78 Resize settings

Use the **Preserve aspect ratio** check box to preserve initial proportions during image size change.

3. **Raster expansion** (in the window opened by menu command **Processing | Raster expansion**) – the operation is used to add a background of selected size (in pixels) to each side of the image. Background color is selected from appropriate drop-down list.

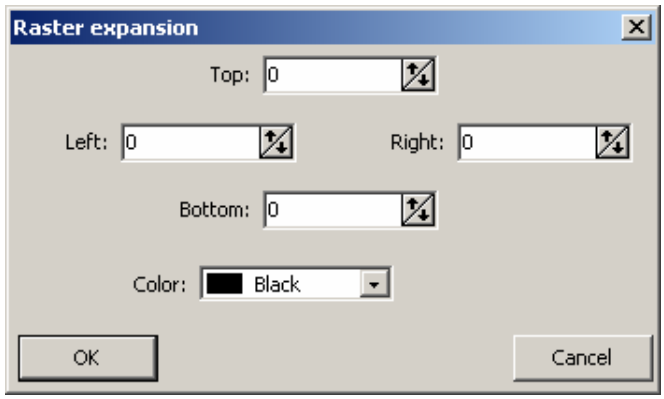


Fig.79 Raster expansion settings

4. **Edges trimming** (in the window opened by menu command **Processing | Trim edges**) – the operation is used to eliminate pre-set part of an image (in pixels) from each edge of raster.

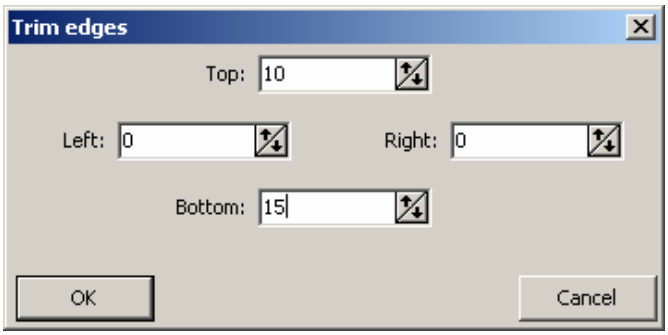


Fig.80 Edges trimming settings

19.3.3. Batch processing

In some cases it is suitable to apply transformations to a batch of images. Select menu command **Processing | Batch processing**, to make settings of images batch processing that allows to open the following window.

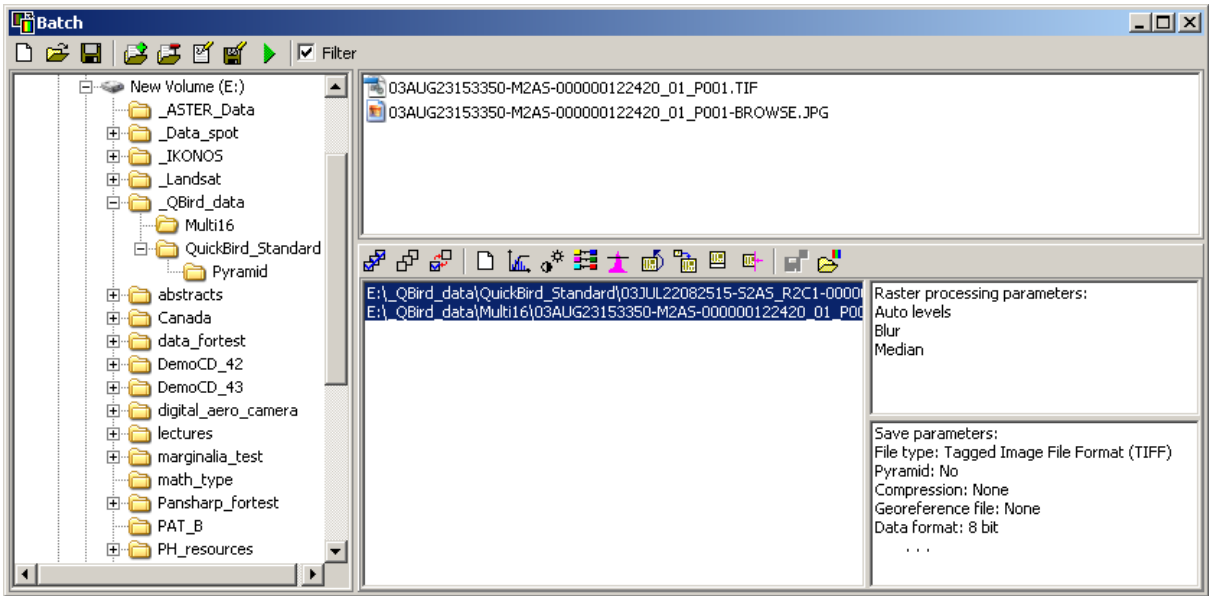


Fig.81 Batch processing window

Upper toolbar contains the following buttons:

- new project – creates new project of batch processing

- open batch project – opens existing project of batch processing (file with RPB extension)

- save batch project – allows to save a project of batch processing to new file with RPB extension

- add images – adds image selected in upper file list to list of images for batch processing

- delete images – deletes selected image from list of images for batch processing

- edit image – opens window of radiometric image correction, see the chapter 19.3.1 Radiometric correction

- edit output parameters – opens window for file name input, and then window for saving setup of batch processing results, see the chapter 19.3.6 Image saving

- start batch processing – starts batch processing for selected images.

See the description of batch processing setup in the chapter 19.3.3.1 Batch processing setup.

19.3.3.1. *Batch processing setup*

First of all you should select a folder containing images to be included into batch processing, using left panel of the batch processing window (**1**).

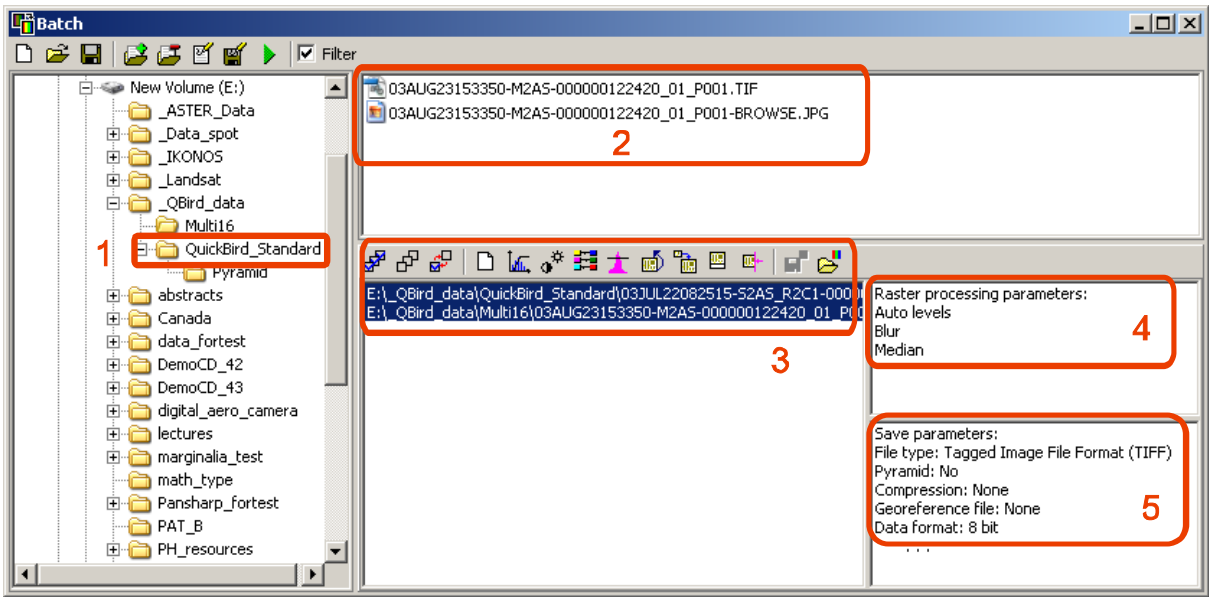


Fig.82 Batch processing setup

Content of a folder selected is shown in the list of upper panel (**2**).

Mark the **Filter** checkbox to show only raster file names in this list that are processed in **PHOTOMOD GeoMosaic** module, see the chapter 19.3 Work in application.

After selecting of file with image push the button (**Add images**) or double click the file name to add the image to the list of batch processing files in lower panel (**3**). Select more images to be processed in batch mode in the same way.

You can include/exclude images to batch processing using the following tools.

To select all images in the panel **3** use the button **Select all**, to clear selection of all images click the button **Unselect all**, to invert selection click the button **Invert selection**.

For the image selected in the panel **3** you can make settings for its radiometric and geometric correction and saving. Use buttons of the toolbar above the panel **3** to select and setup radiometric and geometric operations, see the chapter 19.3.1 Radiometric correction and 19.3.2 Geometric transformations. The panel **4** then will contain a list of selected processes for each image.

You can make settings for save operation by clicking the button (**Edit output parameters**). In the window opened select target file name and path, then in the next opened window make necessary settings, see the chapter 19.3.6 Image saving. Saving preferences will be shown in the panel **5**.

You can save a set of your operations selected for chosen image or images to file with CNV extension by clicking the button (**save conversion of current image**).

This operations set could be applied then to another image or images, selected in the panel **3**. For that click the button (**apply conversion to selected images**) and select CNV file.

When all necessary images are selected and operations are setup push the button (**Start batch processing**) to launch the processing. After that the window of save settings of batch processing results will be opened, if the settings were not selected previously.

19.3.4. Operations with image fragment

You can select an image fragment by mouse drag over the area you want to select holding down **Shift**. The fragment boundary is shown by green dashed line with small rectangles on its sides. Drag the rectangles to resize the fragment.

Copy the fragment selected to the clipboard (by **Ctrl-C**), and then paste it to a new window (by **Shift-Ctrl-V** shortcut).

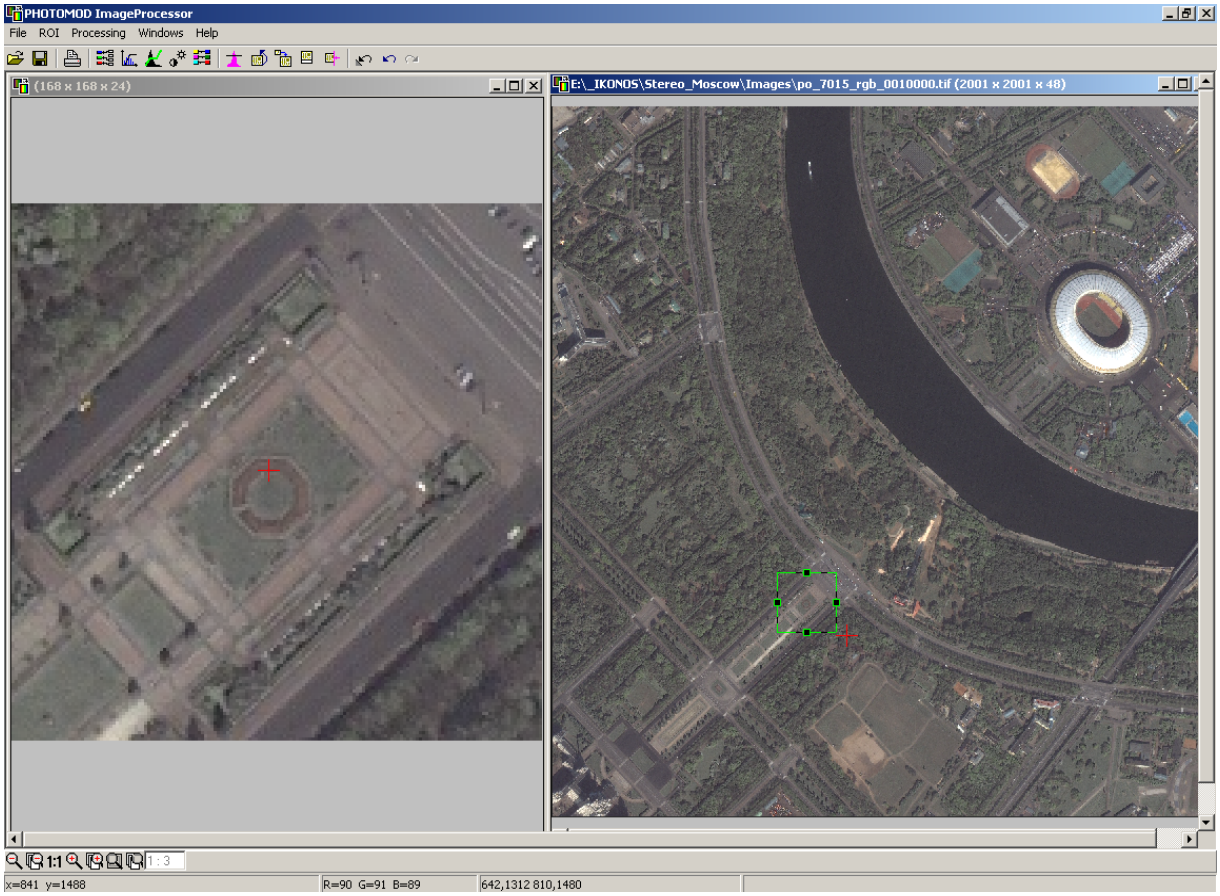


Fig.83 Initial image (right) and its fragment

You can apply operations of radiometric correction (see the chapter 19.3.1 Radiometric correction) and geometric transformation (see the chapter 19.3.2 Geometric transformations) to the fragment selected.

After completing of all necessary processing of the image fragment you can print it (see the chapter 19.3.5 Image printing) and/or save (see the chapter 19.3.6 Image saving).

19.3.5. Image printing

Use menu command **File | Print** (or the button) to print the image or its fragment. Make necessary settings in the window opened.

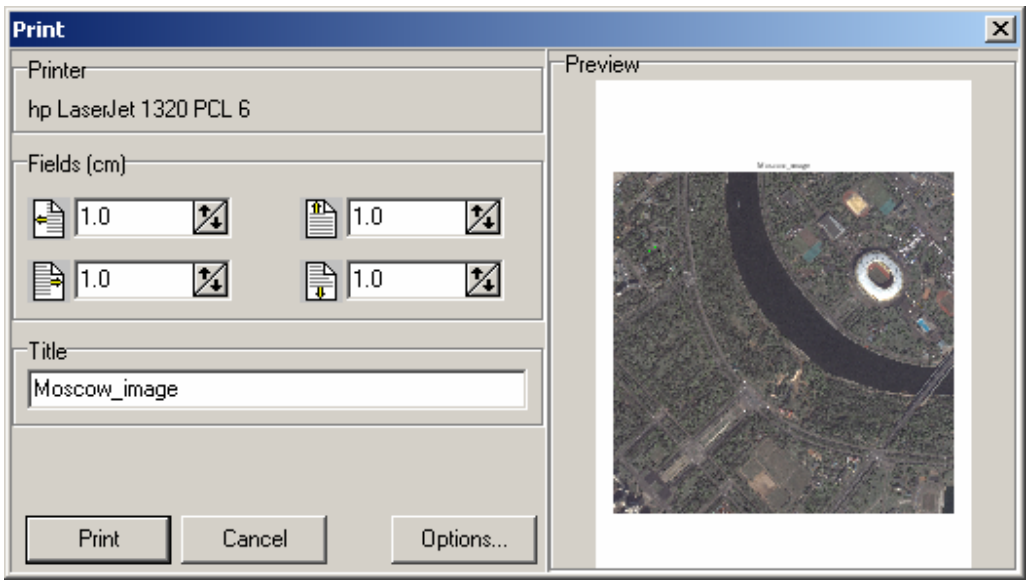


Fig.84 Printing settings

In the left part of the window you can adjust the printing options: offsets, printer selection and its preferences (using the **Options** button), and input a title of the image to be printed in the appropriate field. Use the **Preview** window to the right to view printing settings.

Push the **Print** button to start printing, or **Cancel** – to cancel printing and close the window.

19.3.6. Image saving

Use menu command **File | Save** (or the button) to save the image or its fragment. If you need to save the image to file with new name select menu command **File | Save as** (or the button), which opens the following window.

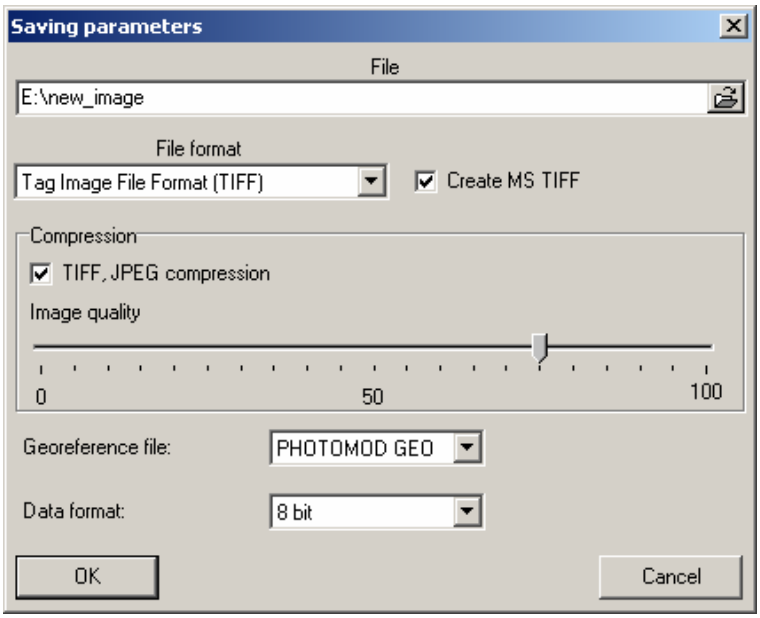


Fig.85 Image save settings

The image will be saved with name indicated in the **File** field in one of the following formats selected in the **File format** drop-down list:

- **Tag Image File Format (TIFF)** – allows to save output file with or without JPEG compression (depending on the option in the **Compression** panel, see below)
- **Windows Bitmap File (BMP)**
- **GIS Panorama raster map (RSW)** – raster format of Panorama system (see the chapter 12 Export mosaic to PHOTOMOD VectOr)
- **GeoTIFF** – TIFF format, containing special tags with georeference
- **ERDAS IMAGINE (IMG)** – raster format of ERDAS system
- **NITF (NITF)**
- **JPEG (JPEG)**
- **PNG (PNG)**
- **MicroStation DGN (DGN)** – raster format of MicroStation system
- **PCIDSK (PIX)** – raster format with georeference data in its header, developed by PCI Geomatics
- **JPEG2000 (JP2)** – raster format with jpeg-compressing and georeference data in its header, output image in this format has limited volume up to 500 Mb.

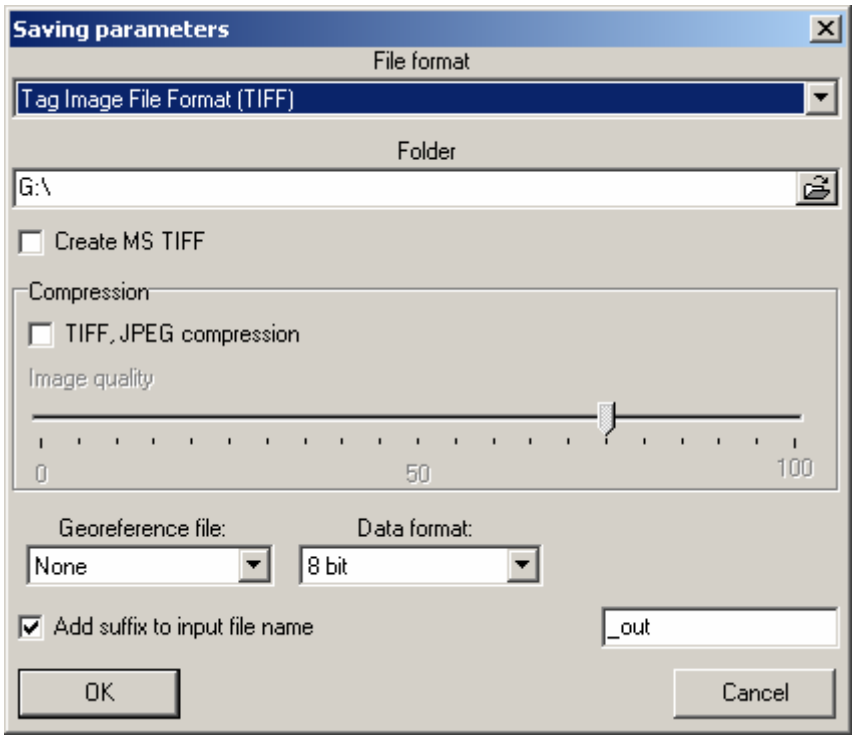
Options in the **Compression** panel are used to compress the output mosaic image. Check the **TIFF, JPEG compression** box and use the slider **Image quality** if you want to apply the compression. The default value of compression is 75% (usually it causes the 5-7 times compression of initial image volume).

When saving the image to TIFF format you may save also image pyramid into the file, i.e. transfer it to MS TIFF format, if the checkbox **Create MS TIFF** is marked. Moreover when saving to TIFF you may select output image resolution (8 or 16) in the **Data format** drop-down list. It is usually used for transformation of initial 16-bit raster into 8-bit one.

To save image georeference into separate file select its format in the **Georeference file** drop-down list. See the chapter 15 Georeference file.

After selecting all parameters click **OK** to start saving or **Cancel** to cancel it.

In batch processing mode, the following window opens for selecting parameters for saving files:



Images will be saved in the folder specified in the field **Folder**, with format chosen from the dropdown list **File format**. List of and options for available formats are the same as for saving single image.

To save image georeference into separate file select its format in the **Georeference file** drop-down list. See the chapter 15 Georeference file.

It is also possible to set a suffix which will be appended to the names of source files when saving images. This is controlled by **Add suffix to input file name** option. This may be used for example when saving output files to the same folder as input files.

After selecting all parameters click **OK** to start processing or **Cancel** to cancel it.